GENUINE
Trussell ®
MADE IN U.S.A.
176TBLH
VIRGIN PLASTIC

NAV-750, A

VOR/LOC/COMM AND G/S BENCH TEST SET

MANUAL PART NO. 1-16-0245

DATE PRINTED: MAR 1975

4053 Navajo Lane/Wichita, Kansas 67210 U.S.A./316/685-9271/TWX. 910-741-6952

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NAV-750

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MANUAL CHANGES

MODEL NUMBER — NAV-750,A
DATE PRINTED —— MARCH 1975
PART NUMBER —— 1-16-0245

This Supplement contains important additional technical data for updating the Manual, and correction data for removing Manual errors.

Incorporate all appropriate model or serial number related changes in your copy of the NAV-750,A Manual, IFR P/N 1-16-0245. These changes are indicated in the table below.

Serial Prefix or Model	Make Manual Changes
All Serial Numbers	1,2,3,4,5,6,7,8, and 13
NAV-750's only	9, 10
NAV-750A's only	11

ERRATA

(1) Page 1-12, Power Requirements Specification:
Add the following: (Cooling fan 50/60Hz only)

(2) Page 2-4, Paragraph 2-9.1.C:
First sentence should read: Capacitors. Inspect...

(3) Pages 3-13 and 3-14:
DELETE paragraphs 3-26.1, 3-27.1, and 3-28.1

(4) Page 3-14, paragraph 3-31.1:
First sentence should read: All the above information contained in paragraphs 3-21.1 through 3-30.1 applies...

(5) Page 5-6, paragraph 5-15:
Last sentence should read: Refer to page 6-19, paragraph 6-35.

(6) Page 5-10, paragraph 5-25:
Sentence following control settings should read: Refer to Figures 1-1 and 6-31.

(7) Page 5-17:
REMOVE and discard the present page 5-17 and replace it with the new page 5-17 included as part of this Supplement package. The new page 5-17 has the date code 5182 in the lower left corner.

(8) Page 6-2, paragraph 6-7:
Last line should read: ...may be found in Figure 4-2, page 4-7.

(9) Page 6-36, Required Test Equipment and Fixtures:
Oscilloscope specification should read: ...Dual-Trace, 40 MHz minimum frequency response. (typically DUMONT 1052)

(10) Page 6-36, paragraph 6-69:
Last sentence should read: Connect the oscillator and other RF assemblies as shown in Figure 6-27.

(11) Page 6-55, paragraph 6-109.1:
First sentence, second line, should read: ...and the TEE connector as shown in Figure 6-28.

(12) Page 7-13, paragraph 7-57:
The third line from the bottom should read: ...frequency by 2,4,8, and 10 observing the 2^0 (1 or A), 2^1 (2 or B), 2^2 (4 or C), and 2^3 (8 or D) outputs.

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SECTION I

General Information

1-1. NAV-750 Description.

1-2. The NAV-750 is a precision simulator of VOR, LOC, G/S and COMM ground stations. It is completely self-contained and no other equipment is necessary for full operation. However, the NAV-750 may be externally controlled to change output frequencies, or it can remotely channel a receiver with a two out of five select system.

1-3. The VOR section provides bearings every 30° with plus or minus 10 degree steps by push button switches. From any heading the bearing can be indefinitely varied in.01 or .05 degree steps. All VOR frequencies are provided with calibrated, variable output.

1-4. The LOC and G/S sections use precision 90 and 150Hz tone generators accurately mixed to provide "on-course" and certain specified deviations. All LOC and G/S frequencies are available with calibrated output.

1-5. COMM receiver testing is accomplished by an RF generator with all frequencies from 118.00 to 156.00 MHz available in 25 kHz steps. A 1020Hz tone may be added.

1-6. In all modes, the RF generator is crystal-controlled and phase-locked in 25 kHz steps, if desired. Automatic frequency stepping at a variable rate is provided, selectable in 25, 50, 100, or 200 kHz intervals.

1-7. WARRANTY. (See following page)

WARRANTY AND SERVICE INSTRUCTIONS

A. Warranty.

B. IFR, Inc., warrants that each new instrument manufactured by it is free from defects in material or workmanship under normal use and service for a period of two years from the shipping date. (NOTE: 90 day warranty on battery pack). Each instrument is functionally tested immediately prior to shipment. If, upon examination by IFR, the instrument is determined to be defective in workmanship or material, IFR will, subject to the conditions set forth below, either repair the defective part or replace it with a new part on a pro rata basis. IFR shall not be liable for any delay or failure to furnish a replacement part resulting directly or indirectly from any governmental restriction, priority or allocation or any other governmental regulatory order or action, nor shall IFR be liable for damages by reason of the failure of the instrument to perform properly or for any consequential damages. The warranty does not apply to any instrument that has been subject to negligence, accident, shipping damage, misuse or improper installation or operation, or that in any way has been tampered with, altered or repaired by any person other than an authorized IFR service organization or any employee thereof, or to any instrument whose serial number has been altered, defaced or removed, or to any instrument purchased within, and thereafter removed beyond, the continental limits of the United States. Annual recalibration is not included in warranty.

C. All sales are FOB IFR Factory, Wichita. IFR will assume responsibility for freight charges on all legitimate warranty claims within thirty (30) days from the original shipping date. All legitimate warranty claims within thirty (30) to ninety (90) days should be shipped to IFR freight collect and will be returned freight collect. All freight on warranty claims after ninety (90) days will be paid by the customer.

D. This warranty shall, at IFR's option, become void if the equipment ownership is changed, unless the prior owner or the proposed owner obtains approval of continuation of the warranty prior to the change of ownership.

E. This warranty is in lieu of all other warranties, expressed or implied, and no one is authorized to assume any liability on behalf of IFR or impose any obligation upon it in connectioon with the sale of any instrument, other than as stated above.

F. Changes in Specifications.

G. The right is reserved to change the published specifications of the equipment at any time and to furnish merchandise in

accordance with current specifications without incurring any liability to modify equipment previously sold, or to supply new equipment in accordance with earlier specifications except the classification of special apparatus.

H. Service.

I. When requesting service, the originator shall give IFR information concerning the nature of the failure and the manner in which the equipment was used when the failure occurred. Type, model, and serial number should also be provided.

J. Do not return any products to the factory without first receiving authorization from the factory Customer Service Department.

CONTACT:

IFR, Inc.
4053 Navajo Lane
Wichita, Kansas 67210 USA

ATTN: Customer Service Department

PHONE: (800) 835-2350 (Customer Service Only)

TWX: 910-741-6952

K. Unless otherwise specifically requested, packaging for a return shipment shall be in the original container and packaging material. If the original container and material are not available, information as to suitable packaging techniques will be provided by the IFR Shipping Department.

L. Returned material claimed defective, but found to meet all previously applicable specifications, will be subject to a minimum evaluation charge consisting of the labor charges involved in the status determination of the material.

M. Returned material not accompanied by statement of claimed defects may be returned at the originator's expense.

N. Any departure from the above instructions without specific factory authorization can be considered a breach of warranty, and all expenses incurred as a result will be billed to the originator.

Spectral Purity

Harmonics (With -30 dBm RF output attenuator setting)

Greater than 30dB below carrier level at any selected frequency.

Close-In Noise

108.0 MHz - greater than 74dB below carrier level at ±20 kHz.

334.7 MHz - greater than 68dB below carrier level at ±40 kHz.

Nonharmonic Spurious Noise (The phase-lock control frequency in in the NAV-750 is 12.5 kHz)

±12.5 kHz - 68dB below carrier level
±20.0 kHz - 74dB below carrier level
±25.0 kHz - 71dB below carrier level

Level below carrier stated in a 300Hz bandwidth.

(Above levels observed with a carrier frequency of 108.0 MHz and a carrier level of -30 dBm)

Broadband Noise

Greater than 80 dB below carrier level at selected frequencies ±50 kHz or greater away from the carrier frequency.

Residual FM

(Post-detection noise bandwidth - 20Hz to 15 kHz)

108.0 MHz - ± 200Hz P-P or less
334.7 MHz - ± 400Hz P-P or less

Spectral Purity

Harmonics (With -30 dBm RF output attenuator setting)

Greater than 30dB below carrier level at any selected frequency.

Close-In Noise

108.0 MHz - greater than 78dB below carrier level at ±15 kHz.

334.7 MHz - greater than 74dB below carrier level at ±40 kHz.

Nonharmonic Spurious Noise (The phase-lock control frequency in the NAV-750A is 12.5 kHz.)

±12.5 kHz - 75dB below carrier level
±15.0 kHz - 78dB below carrier level
±25.0 kHz - 83dB below carrier level

Level below carrier stated in a 300Hz bandwidth.

(Above levels observed with a carrier frequency of 108.0 MHz and a carrier level of -30 dBm)

Broadband Noise

Greater than 80dB below carrier level at selected frequencies ±50 kHz or greater away from the carrier frequency.

Residual FM

(Post-detection noise bandwidth - 20Hz to 15 kHz)

108.0 MHz - ±200Hz P-P or less
334.7 MHz - ±400Hz P-P or less

NAV-750
RF SPECTRUM

NAV-750 RF Output	-20 dBm
NAV-750 RF Frequency	108 MHz

SPECTRUM ANALYZER SETTINGS

Log Ref Level	-30
Scan Width	5 kHz

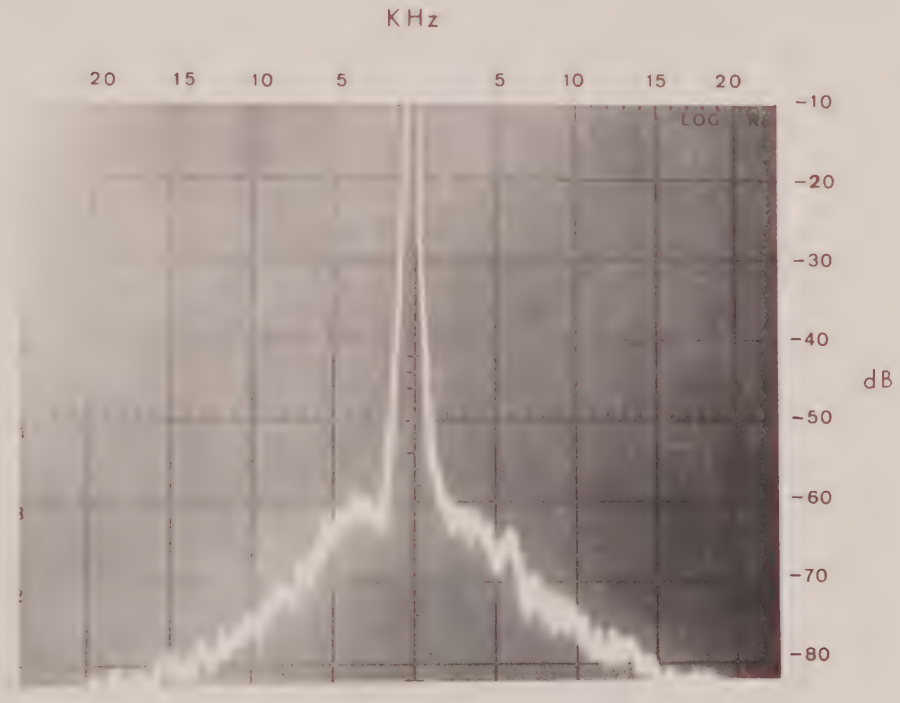


FIGURE 1-1

Input Attenuation	0
Bandwidth	300Hz
Scale	10dB Log
Scan Time	2 sec
Video Filter	10Hz

SPECIFICATIONS

NAV-750
(Without Option A)

RF Power Out:

Accuracy:	±1.5dB to -50 dBm ±2.5dB from -50 dBm to -120 dBm
Leakage: (With all unused outputs properly terminated)	Less than 3uV induced in a two-turn, one inch diameter (#20 ga wire) loop, measured one inch away from any surface and into a 50 ohm receiver.

Modulation:

AM Depth:	0-98%
Absolute Accuracy: (Reading front panel meter)	1.0% at 20% modulation 1.5% at 30% modulation 2.0% at 40% modulation

Spectral Purity:

Harmonics:	Greater than 30dB below carrier level at any selected frequency.
Noise: (Level below carrier stated in a 300Hz bandwidth)	108.0 MHz - greater than 74dB below carrier level at ±20 kHz. 334.7 MHz - greater than 68dB below carrier level at ± 40 kHz.
Residual FM: (Post-detection noise bandwidth 20Hz-15 kHz)	108.0 MHz - less than ± 200Hz P-P 334.7 MHz - less than ± 400Hz P-P

Internal Reference Oven Xtal:

Aging:	Less than ± 2ppm/yr
Generator Frequency	Better than ± 1ppm for 15° to 35°C
Accuracy: (After calibration at 25°C)	Better than ± 3ppm for 10° to 45°C

Section II

SPECIFICATIONS

NAV-750A

RF Power Out:

Accuracy:	± 1.5 dB to -50 dBm ± 2.5 dB from -50 dBm to -120 dBm
Leakage: (With all unused outputs properly terminated)	Less than 3uV induced in a two-turn, one inch diameter (#20 ga wire) loop, measured one inch away from any surface and into a 50 ohm receiver.

Modulation:

AM Depth:	0-98%
Absolute Accuracy: (Reading front panel meter)	1.0% at 20% modulation 1.5% at 30% modulation 2.0% at 40% modulation

Spectral Purity:

Harmonics:	Greater than 30 dB below carrier level at any selected frequency
Noise: (Level below carrier stated in a 300Hz bandwidth)	108.0 MHz - greater than 78 dB below carrier level at ± 15 kHz. 334.7 MHz - greater than 74 dB below carrier level at ± 40 kHz.
Residual FM: (Post-detection noise bandwidth -- 20Hz-15 KHz)	108.0 MHz - less than ± 200Hz P-P 334.7 MHz - less than ± 400Hz P-P

Internal Reference Oven Xtal:

Aging:	Less than ± 2ppm/yr
Generator Frequency Accuracy: (After calibration at 25°C)	Better than ± 1ppm for 15° to 35°C Better than ± 3ppm for 10° to 45°C

DDM ACCURACY AT POSITIONS OTHER THAN CENTERING

COMPOSTE AUDIO ERROR = Centering Error + 1.5% DDM Setting

$$\text{PERCENTAGE OF MODULATION ERROR} = \text{DDM Setting} \times \frac{\left(\begin{array}{c}\text{measured, single-}\\ \text{tone, \% of modu-}\\ \text{lation at centering}\end{array}\right) - \left(\begin{array}{c}\text{desired \% of}\\ \text{modulation at}\\ \text{centering}\end{array}\right)^{*}}{\left(\begin{array}{c}\text{Desired \% of modulation}\\ \text{at centering}\end{array}\right)^{*}}$$

TOTAL ERROR = COMPOSITE AUDIO ERROR + PERCENTAGE OF MODULATION ERROR

* desired % of modulation at centering for LOCALIZER 20%
* desired % of modulation at centering for GLIDE SLOPE 40%

DDM setting	Composite Audio Error (DDM)	max % of Mod Error (DDM)	TOTAL (maximum error) (DDM)
LOCALIZER:			
.046	.00169	.00230	.00399
.093	.00240	.00465	.00705
.155	.00333	.00775	.01108
.200	.00400	.01000	.01400
GLIDE SLOPE:			
.045	.00168	.00225	.00393
.091	.00237	.00455	.00692
.175	.00363	.00875	.01238
.400	.00700	.02000	.02700

NAV-750A

DDM ACCURACY AT POSITIONS OTHER THAN CENTERING

COMPOSITE AUDIO ERROR = Centering Error + .02% DDM Setting

$$\text{PERCENTAGE OF MODULATION ERROR} = \text{DDM Setting} \times \frac{\left(\begin{array}{c}\text{measured, single-}\\ \text{tone, \% of modu-}\\ \text{lation at centering}\end{array}\right) - \left(\begin{array}{c}\text{desired \% of}\\ \text{modulation at}\\ \text{centering}\end{array}\right)^{*}}{\left(\begin{array}{c}\text{Desired \% of modulation}\\ \text{at centering}\end{array}\right)^{*}}$$

TOTAL ERROR = COMPOSITE AUDIO ERROR + PERCENTAGE OF MODULATION ERROR

*desired % of modulation at centering for LOCALIZER 20%
*desired % of modulation at centering for GLIDE SLOPE 40%

DDM setting	Composite Audio Error (DDM)	max % of Mod Error (DDM)	TOTAL (maximum error) (DDM)
LOCALIZER:			
.046	.00101	.00230	.00331
.093	.00102	.00465	.00567
.155	.00103	.00775	.00878
.200	.00104	.01000	.01104
GLIDE SLOPE:			
.045	.00101	.00225	.00326
.091	.00102	.00455	.00557
.175	.00104	.00875	.00979
.400	.00108	.02000	.02108

Technical Summary

VOR Section:

Bearing Selection:	Twelve preset headings each 30°. Additional +10° and -10° steps from any bearing selected. Bearing knob gives continuous bearing adjustment in .01° or .05° steps.
Bearing Accuracy:	± .05° on all headings
Bearing Monitor:	By independent counter; displays bearing to .01° resolution.
VOR Tones:	30Hz REF and 30Hz VAR tones derived from 2.16 MHz crystal oscillator. 9960Hz is frequency locked to the 2.16 MHz crystal.
Ident Tone:	1020Hz tone may be added at 0 to 60% mod.

LOC Section:

Deviation:	± .046 DDM, ± .093 DDM, ± .155 DDM, and continuously adjustable ± .4 DDM. One tone may be deleted while the other is at 20%.
Centering Accuracy:	± .001 DDM (± .85uA)
Tones:	90Hz and 150Hz tones phase-locked to ± .1° or phase variable at five times the angle selected by the VOR bearing selector. 1020Hz tone may be added.

GS Section:

Deviation:	± .045 DDM, ± .091 DDM ± .175 DDM, and continuously adjustable ± .8 DDM. One tone may be deleted while the other is at 40%.

Centering Accuracy:	± .001 DDM (± 1uA)
Tones:	Same as LOC

COMM Section:

Modulation:	1020Hz tone 0-60% for audio tests. External modulation may also be added.

RF Generator:

Frequency Range:	108 to 156 MHz in 25 kHz increments. 329 to 335 MHz.
Frequency Selection:	Manually by thumbwheel switch. Automatically at a variable rate in 25, 50, 100, or 200 kHz increments, up in frequency only. Auto channeling stops at 117.95 and 135.975 MHz. Channeling may also be done by external input at rear panel.
Variable Frequency:	±50 kHz from 108 to 156 MHz ±150 kHz from 329 to 335 MHz. Generator remains phase locked at all fixed and variable frequencies.
Frequency Accuracy:	Controlled by oven crystal to ± .00020%.
Frequency Monitor:	By independent counter to 1 kHz or 0.1 kHz resolution. Counter time base ± .0001%.
Remote Function:	Frequency in use fed to rear panel as 2 out of 5 channeling. Remote channeling follows manual or auto selection.
Modulation Selection:	Automatic by frequency selected. VOR mod applied if on any VOR freq, LOC mod applied if on any LOC freq, GS mod applied if on any LOC freq and LOC/GS switch in GS position.

External Modulation:	May be added to any signal through rear panel jack. (J18)
Impedance (J18):	1K ohm nominal
Sensitivity:	9.1V P-P (±0.6V) = 30% (MASTER MOD in Cal position)
Demod Output:	For any signal at a rear panel jack. (J23)
Impedance (J23):	1K ohm nominal
DC Voltage:	3.75V (±0.3V)
AC Voltage:	2.72V (±0.2V) = 100% Modulation (±0.2V due to differences in sets)
Rear Panel Connectors:	External Modulation Input VOR Composite Tones output VOR 30Hz VAR Tone output VOR 9960Hz FM Tone output 1020Hz Tone output VOR 30Hz REF Tone output 150Hz Tone output 90Hz Tone output RF Demod output AC Power Input (See power requirements below) External Clock Input Remote Channeling Input Remote Channeling output
Power Requirements:	105 to 120 VAC or 220 to 250 VAC, 50 to 400Hz 90 WATTS DISSIPATED COOLING FAN 50/60HZ ONLY
Size:	7.5" high by 16.75" wide by 18.375" deep
Weight:	Approximately 40 pounds (45 pounds with option A)

SECTION II

Inspection

2-1. Inspection.

2-2. This instrument was carefully inspected both mechanically and electrically before shipment. It should be physically free of mars or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage in transit. Also, check for supplied accessories, and test the electrical performance of the instrument using the procedure outlined in Section V of this manual. If there is any damage or deficiency, file a claim with the carrier, and refer to the Warranty portion in Section I of this manual. If it should become necessary to ship the instrument, refer to paragraph 1-K for shipping instructions.

2-3. Grounding Requirements.

2-4. To protect operating personnel, the National Electrical Manufacturer's Association (NEMA) recommends that the instrument panel and cabinet be grounded. All IFR instruments are equipped with a three-conductor power cord which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cord three-prong connector is the ground wire.

2-5. To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the green pigtail on the adapter to ground.

2-6. Rack/Bench Installation.

This instrument is initially shipped as a bench-type instrument (unless ordered specifically as a rack type) with plastic feet in place. Conversion to a rack-mounted instrument can be accomplished by using the Rack Mounting Kit available from the factory upon request.

2-7. Repackaging for Shipment.

2-8. The following is a general guide for repackaging for shipment. If you have any questions, contact the IFR Shipping Department. (See Section I, Paragraph K)

NOTE

If the instrument is to be shipped to IFR for service or repair, attach a tag to the instrument identifying the owner and indicating the service or repair to be accomplished; include the model number and full serial number of the instrument. In any correspondence identify the instrument by prefix, model and serial number.

Place instrument in original container if available. If original container is not available, contact IFR for shipping instructions.

Do not return the instrument or its component parts to IFR, Inc. for repair without first receiving authorization from IFR, Inc. Refer to paragraph 1-H for complete instructions.

SECTION II

Inspection/Check

2-1.1 Introduction.

2-2.1 This section presents instructions to determine, by inspection, the general condition of the NAV-750 and possible faults found through either normal operation or performance tests.

2-3.1 It has been found through hard experience that deliberate moving, however slight, of the discrete components on the various PC boards or other assemblies will often cause circuit problems which were not originally causes of problems. This can quickly change simple problems into complex ones. Therefore the factory recommends only a close visual inspection without touching the components.

2-4.1 Cleaning.

2-5.1 It is wise to clean the dust, cobwebs, etc., out of the test set prior to inspection, repair, or calibration. Some shops clean their test equipment on a regular basis such as bi annual or annual proof-of-performance checks.

2-6.1 It is recommended that dust removal be done with a hand controlled dry air jet of not too high pressure (25-50 psi). The fan blades, rotor and frame should be wiped with a lint-free cloth moistened with rubbing alcohol. The rear panel should be cleaned with a dry cloth only. The front panel may be cleaned whenever necessary with a lint-free cloth moistened with rubbing alcohol.

2-7.1 Care must be taken to avoid breaking wires or shorting component leads together during cleaning.

2-8.1 Inspection/Check.

2-9.1 Procedures.

A. Bearing Pickoff Sensors. The bearing pickoff sensors may be located by looking at the Top View Fig 8-1 Accumulated dirt can cause sluggish operation or failure of the bearing pickoff sensors. It may be cleaned with a soft brush moistened with rubbing alcohol.

B. Chassis. Includes anything mechanical or made from metal. Inspect for tightness of sub-assemblies, damaged connectors, corrosion or damage to the metal surfaces, etc. Surface corrosion may indicate damage inside the affected part.

C. Inspect for loose mounting, body damage, case damage, leakage or corrosion around leads.

D. Jacks. Inspect all coax jacks for loose or broken parts, cracked insulation, bad contacts, etc. Do not disassemble connectors within the test set.

E. Potentiometers. Any potentiometer that feels rough when rotated or produces circuit or voltage irregularities should be checked with an ohmmeter for proper operation.

F. Resistors. Inspect all types of resistors for cracked, broken or charred or blistered bodies and loose or corroded soldering connections.

G. Printed Circuit Boards. Check connectors for corrosion and damage and the mating plugs for similiar damage. Inspect all mounted componets for damage including crystals and IC's. The boards should be free of all foreign material.

H. Semiconductors. Inspect all diodes, rectifiers and transistors for cracked, broken, charred or discolored bodies. Check ends of components for seals around leads.

I. Switches. Examine all toggle switches for loose levers and terminals, loose body to frame condition. The line switch contacts should not be bent nor the switch action too loose. The thumbwheel switches should have definate detents and not feel loose.

J. Transformer. Inspect the transformer for signs of excessive heating, broken or charred insulation, loose mounting hardware and other abnormal conditions.

K. Wiring. Inspect all wiring of chassis for broken or loose ends and connections and proper dress relative to other chassis parts. All laced wiring should be tight with ends securely tied.

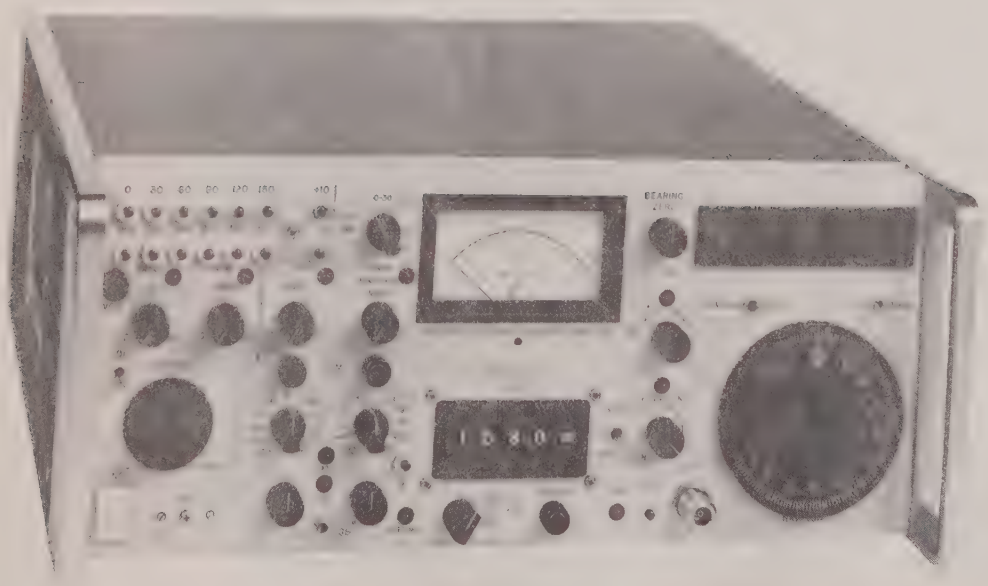
SECTION III

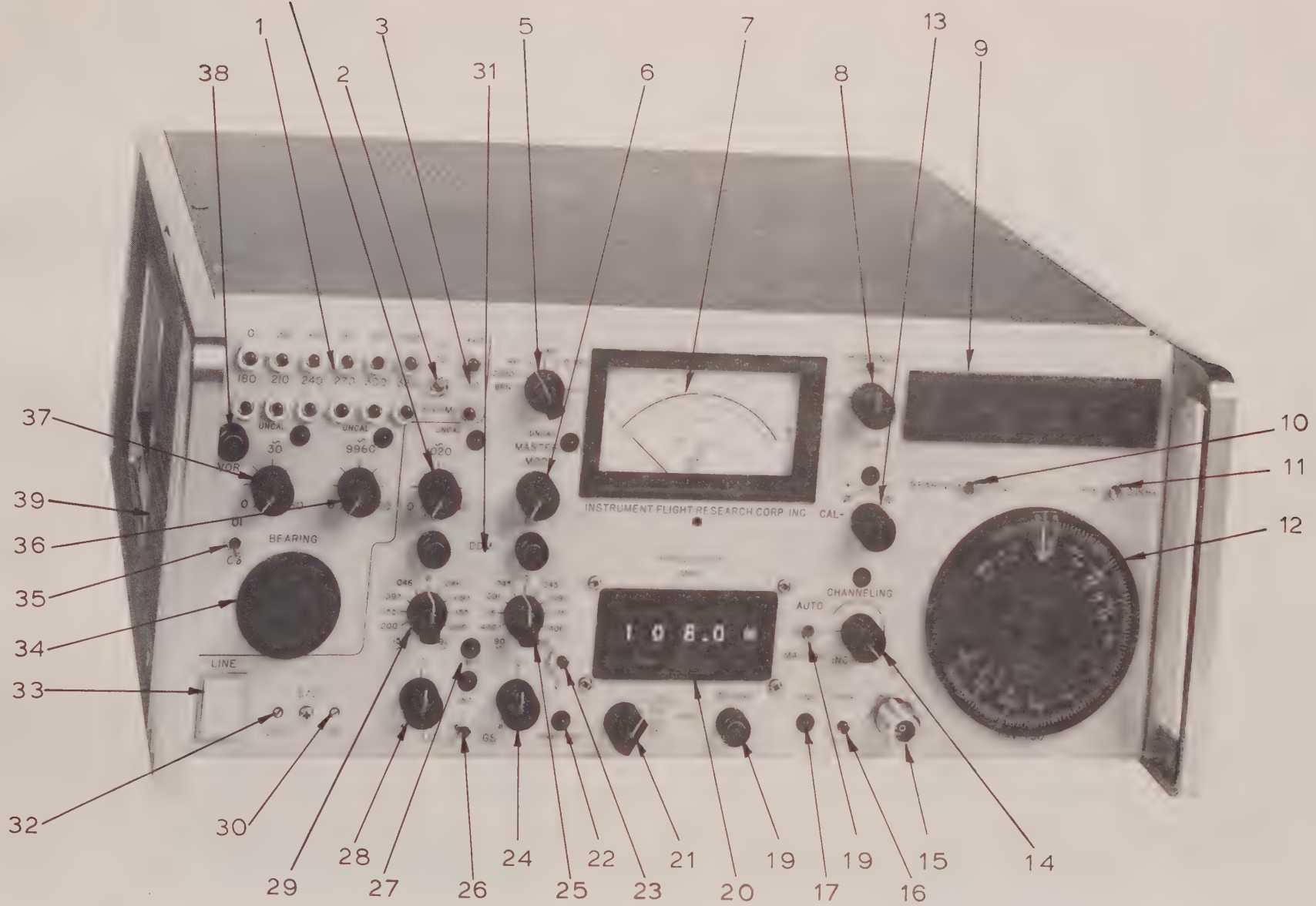
Operation

3-1. Introduction.

3-2. This section contains instructions and information necessary for operation of the IFR Model NAV-750 VOR/LOC/COMM/ and GS Bench Test Set.

3-3. Included in this section are identification of front and rear panel controls, indicators and connectors; operation with equipment being tested and information useful in applications for NAV-COMM testing.





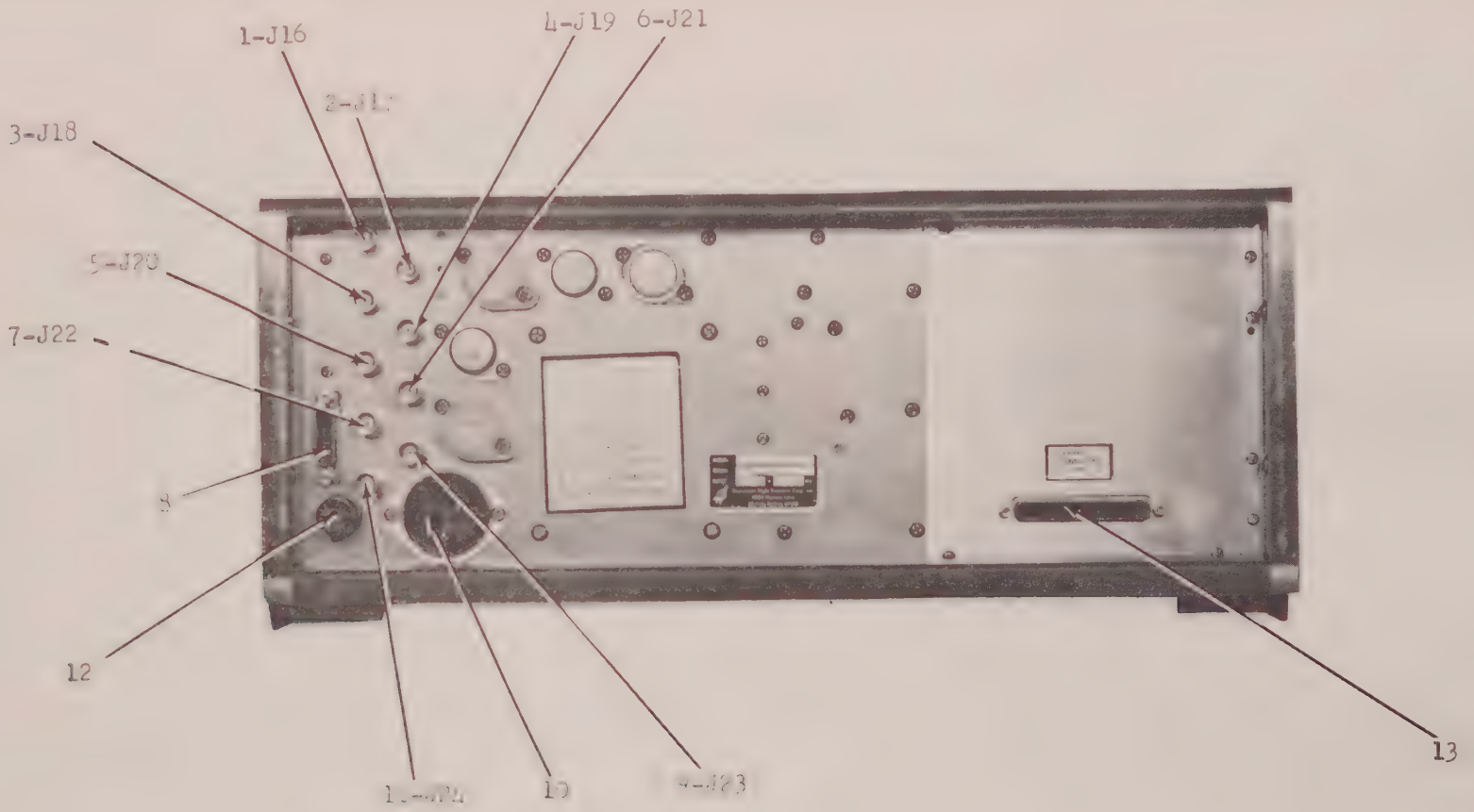
FRONT PANEL CONTROLS, CONNECTORS, AND INDICATORS

NAV-750

FIG. 3-1

FRONT PANEL		Paragraph
1.	VOR Bearing Select Pushbutton Switches	3-6
2.	TO/FROM Bearing Switch	3-7
3.	± 10 degree Bearing Pushbutton Swithes	3-8
4.	1020Hz Ident Tone Modulation Level Control	3-9
5.	Meter Function Switch	3-10
6.	Master Modulation Level Control	3-11
7.	Meter	3-12
8.	Bearing Zero Adjust Control	3-13
9.	Bearing/Frequency Dispaly	3-14
10.	Display Function Switch	3-15
11.	Frequency Resolution Switch	3-16
12.	Attenuator	3-17
13.	Variable RF Frequency Control	3-18
14.	Channeling Rate Control	3-19
15.	RF Output Connector	3-20
16.	Manual Frequency Stepping Switch	3-21
17.	End Channeling Lamp	3-22
18.	Auto/Manual Frequency Control	3-23
19.	Phase Lock Indicator	3-24
20.	Frequency Select Switches	3-25
21.	Channeling Frequency Increment Switch	3-26
22.	Over-modulation Indicator	3-27
23.	90Hz/150Hz Phase Deviation Switch	3-28
24.	GS Variable Deviation Control	3-29
25.	GS Step Deviation Control	3-30
26.	LOC/GS Frequency Select Switch	3-31
27.	90Hz and 150Hz Tone Off Indicators	3-32
28.	LOC Variable Deviation Control	3-33
29.	LOC Step Deviation Control	3-34
30.	GS Calibration Adjust	3-35
31.	LOC/GS Mode Indicators	3-36
32.	LOC Calibration Adjust	3-37
33.	AC Power Line Switch	3-38
34.	Variable Bearing Control	3-39
35.	.01 or .05 Degree Variable Brg Select	3-40
36.	9960Hz FM Tone Modulation Level Control	3-41
37.	30Hz Tone Modulation Level Control	3-42
38.	VOR Mode Indicator	3-43
39.	Audio Level Control	3-44

REAR PANEL		Paragraph
1.	1020Hz Tone Out	3-46
2.	90Hz Tone Out	3-47
3.	External Modulation Input	3-48
4.	150Hz Tone Out	3-49
5.	9960Hz Tone Out	3-50
6.	Sum of Tones Out	3-51
7.	30Hz Ref Tone Out	3-52
8.	Accessory Plug	3-53
9.	RF Demod Out	3-54
10.	AC input Connector	3-55
11.	30Hz Var Tone Out	3-56
12.	AC Line Fuse	3-57
13.	Remote Channeling Output	3-58



REAR PANEL CONNECTORS

NAV-750

FIG 3-2

Front Panel Controls and Indicators

3-1. General.

3-2. The NAV-750 is a completely self-contained simulator for VOR, LOC, GS and COMM testing of avionics equipment. All necessary signals, audio and RF, are generated and controlled within the one set. In addition, provision is made to remotely channel a receiver for rapid tests of frequency and sensitivity tests, etc.

3-3. Controls, Connectors and Indicators.

3-4. The location of all controls, connectors, and indicators is shown in Figure 3-1 and Figure 3-2. The following paragraphs explain their functions in detail.

3-5. Front Panel.

3-6. VOR Bearing Select Pushbutton Switches. Depressing any of these twelve switches incremented on the 30° cardinal headings instantly sets the VOR Bearing to the heading. The switches may be pressed in ony order or sequence.

3-7. TO/FROM Bearing Switch. Sets the VOR output to a TO or FROM condition. The receiver VOR indicator should agree with the switch position.

3-8. ±10 Degree Bearing Switches. When depressed these switches add or subtract a precise ten degrees from whatever VOR heading the NAV-750 is putting out.

3-9. 1020Hz Ident Tone Mode Level Control. When rotated fully CCW into a detent click position the 1020Hz tone is off in LOC and VOR modes and on with 30% mod level in COMM modes. On COMM the tone may be deleted by setting the control to zero, and it can be varied 0 to 60% mod level from there. On VOR the tone is added as CW rotation is made for mod levels of 0-60%.

3-10. Meter Function Switch. Selects use of meter. The BRG and ZERO positions check the accuracy of the VOR output. RF checks the RF level into the attenuator. The 0-30 and 0-100 positions are for setting or checking the modulation levels of the various signals.

3-11. Master Modulation Level Control. In the full CCW position the mod levels are preset to calibrated levels. When rotated CW these levels can be varied from zero to approx twice normal level or 100%, whichever is greater. An UNCAL lamp indicates when variable levels are in use.

3-12. Meter. Indicates: 1) Bearing deviation in .01 degree increments from zero. 50 on the lower scale represents zero deviation. Each number to the left of 50 is - .01 degrees; to the right of 50 + .01 degrees. Thus 20 is - .03 degrees and 90 is + .04 degrees. 2) Zero sets the bearing check circuit to zero in conjunction with the Bearing Zero Control. 3) RF checks the RF level entering the attenuator to be accurate. 4) 0-30 uses the top scale for 0-30% mod. 5) 0-100 uses the lower scale for 0-100% mod.

3-13. Bearing Zero Adjust Control. Sets the bearing check circuit to zero as indicated by center scale of the meter.

3-14. Bearing/Frequency Display. Reads out the VOR bearing to .01 degrees, or the generator output RF frequency (see 3-16 below).

3-15. Display Function Switch. Selects the readout of the display (see 3-14) to present either frequency or VOR bearing information.

3-16. Frequency Resolution Switch. Selects the display to read to the nearest 1 kHz or 100Hz of RF frequency.

3-17. Attenuator. Sets the RF output level to between -6 dBm to -120 dBm.

3-18. Variable RF Frequency Control. When rotated fully CCW into a detent position the output frequency is that set on the thumbwheel switches or displayed on the readouts. When rotated CW it varies the output frequency ±50 kHz (approx) on the VOR, LOC and COMM frequencies, and ±150 kHz (approx) on the GS frequencies.

3-19. Channeling Rate Control. Sets the rate the channeling (automatic) of the output frequency takes place. Maximum rate is full CW rotation. Full CCW rotation stops automatic channeling.

3-20. RF Output Connector. Presents RF at 50 ohms impedance to be applied to a receiver being tested.

3-21. Manual Frequency Stepping Switch. Used to manually channel the frequency if automatic stepping is not desired. AUTO/MANUAL Select switch must be in AUTO position.

3-22. End Channeling Lamp. Indicates when channeling has reached 117.95 MHz, 135.975 MHz, or 157.95 MHz. Auto channeling will stop when these frequencies are attained.

3-23. Auto/Manual Frequency Control. Selects whether channeling will be controlled automatically or manually.

3-24. Phase Lock Indicator. When on, it shows the RF generator is controlled by the phase lock system. If Off, the generator is out of frequency control.

3-25. Frequency Select Switches. Sets the output frequency of the generator, if the CHANNELING is Off. When channeling is used it sets the starting frequency for channeling, which will increase frequency from start.

3-26. Channeling Frequency Increment Switch. Selects the frequency spacing when channeling is used. The frequency will increase in 25, 50, 100, and 200 kHz steps.

3-27. Over-Modulation Indicator. Indicates when 100% modulation is attained on any frequency.

3-28. 90Hz - 150Hz Phase Deviation Switch. The phase of the 90Hz and 150Hz LOC and GS tones is ordinarily fixed to within ± .1 degree. For testing purposes this phase can be varied by depressing the Phase Deviation Switch. Then the 150Hz tone is retarded by an angle five times greater than the angle of the VOR bearing selector.

3-29. GS Variable Deviation Control. Varies the GS deviation by ± .8 DDM for full rotation.

3-30. GS Step Deviation Control. Selects precise GS deviations in ± .045, .091, .175 and .400 increments. When in either the 90Hz or 150Hz positions that tone only is present in the GS output, the other tone being turned off. In the downward position the variable control (see 3-29) does all GS deviations.

3-31. LOC/GS Frequency Select Switch. In LOC position whenever the Frequency Select Switch is set to a LOC frequency the LOC Mode will be selected and LOC Modulation selected. In GS position the GS Mode and Modulation will be selected if a LOC/GS paired frequency is channeled. VOR channels are selected between the LOC and GS channels.

3-32. 90Hz and 150Hz Tone Off Indicators. When either the LOC or GS Step Deviation Controls are set to 150 or 90Hz the

opposite tone is deleted. The tone deleted is shown by one of the two lamps. Both tones can be deleted at the same time which stops all LOC or GS output (except for Ident tones).

3-33. LOC Variable Deviation Control. Varies the LOC deviation by ± .4 DDM for full rotation.

3-34. LOC Step Deviation Control. Selects precise LOC deviation of ± .046, .093, .155, and .200 DDM. Also deletes a tone or selects a single tone output. Single tones are at a 0 DDM level.

3-35. GS Calibration Adjust. Used to precisely match the 90Hz and 150Hz tone levels. This control varies the 90Hz level to be matched to the 150Hz tone.

3-36. LOC/GS Mode Indicators. Indicates whether the NAV-750 is in LOC or GS.

3-37. LOC Calibration Adjust. Used to calibrate the LOC course centering. Operates same as GS calibration in 3-35.

3-38. AC Power Line Switch. Applies power to test set. Switch is illuminated when power is on.

3-39. Variable Bearing Control. When rotated clockwise the control increases the VOR bearing in .01 or .05 degree steps. If rotated counter-clockwise the bearing is decreased. If 359.99 degrees or 0.01 degrees is reached the bearing starts over continuing around the circle indefinitely. The bearing can be set to any 30° incremental heading by the pushbuttons and then varied with this control, etc.

3-40. .01 or .05 degree Select Switch. Selects whether the Variable Bearing Control increments the VOR heading in .01 or .05 degree steps.

3-41. 9960Hz FM Tone Modulation Level Control. When set fully CCW in the detent position the 9960Hz in VOR Mode is set to 30% modulation. By rotating CW the modulation can be varied 0 to 60%. An indicator lamp shows uncalibrated operation.

3-42. 30Hz Tone Modulation Level Control. This control operates identical to the 9960Hz level control explained in 3-41 except it affects the 30Hz tone.

3-43. VOR Mode Indicator. Shows when the test set is in VOR operation with VOR modulation at the output.

3-44. Audio Level Control. Adjusts the audio level applied to the speaker when channeling is taking place. A short tone burst aurally indicates the test set has advanced to a different frequency.

Rear Panel

3-45. 1020Hz Tone Out. This connector presents the 1020Hz tone for external use.

3-46. 90Hz Tone Out. Same as 3-45 except applies to the 90Hz tone.

3-47. External Modulation Input. External audio tones may be applied to this input to add modulation to any signal except GS.

3-48. 150Hz Tone Out. Same as 3-45 except applies to the 150Hz tone.

3-49. 9960Hz Tone Out. Same as 3-45 except applies to the 150Hz tone.

3-50. Sum of Tones Out. The modulation (total) present on the mode in use - VOR, LOC, GS, COMM - is presented at this connector. Most used for the VOR modulation signal in testing VOR receiver accuracy.

3-51. 30Hz Ref Tone Out. Same as 3-45 except applies to the 30Hz tone. Does not contain the 9960Hz tone.

3-52. Accessory Connector. Various inputs and outputs are presented here, such as remote channeling input, power supply voltages, etc. See Fig (4-3)

3-53. RF Demod Out. The modulation present on the output RF signal is demodulated and applied at this connector.

3-54. AC Input Connector. AC power either 115 VAC or 240 VAC (must be switched internally) is applied here.

3-55. 30Hz Var Tone Out. Same as 3-45 except applies to the 30Hz Var Tone.

3-56. AC Line Fuse. Fuse for AC power input. 1.0A @ 115 VAC, 0.5A @ 230 VAC.

3-57. Remote Channeling Output. Contains channeling information to remotely control a receiver to cause it to "track" the output frequency of the NAV-750. The ARINC 2 out of 5 code is used.

3-58. Internal Controls.

3-59. There are no internal controls useful during normal test set use. Internal adjustments are provided for calibration, which requires use of other pieces of test equipment, etc, and cannot be set in a haphazard manner.

3-1.1 Introduction.

3-2.1 Perh a ps like no other test set has been before, the NAV-750 was designed for greatest ease of operation. Most functions are automatic and signal parameters controlled by the test set itself. Bearing selection is fast and fully digital with instant display to .01 degree. LOC and GS deviations are one-switch operation. Even the operating mode is selected by the frequency in use between the four possible modes. No external pieces of equipment are required. Circuits are built-in to allow calibration of LOC and GS centering, and verify VOR bearing accuracy.

3-3.1 Before initial use of the NAV-750 it is urged that the operator read Section III and get a grasp of the various control functions. They are presented in simple form without other material added. This section will polish your knowledge of the controls and explain connections to other equipments.

3-4.1 VOR Testing.

3-5.1 Equipment Set-Up. Connections to a VOR receiver (as well as LOC, GS and COMM receivers) are shown in Figure 4-1. If remote channeling is not used, only the antenna lead need be connected. For remote channeling refer to figure 4-2, Remote Channeling Connector Pin Assignments. Figure 4-2 gives the ARINC used 2 out of 5 code for reference.

3-6.1 Select a VOR frequency on the Frequency Select Switches. The VOR Mode lamp should come on. Set the CHANNELING RATE control fully CCW to prevent accidental channeling to LOC frequency.

3-7.1 Set the 30Hz, 9960Hz, 1020Hz and MASTER MOD Controls to the full CCW detent click position. All UNCAL lamps for these controls should be off.

3-8.1 The VOR Bearing desired may be set by depressing one of the 30° heading switches, and modifying that heading with the ± 10° switches and the Bearing Select Control. Rotating the control CW increases the heading in .01 or .05 degree steps selected by a nearby switch. CCW rotation reduces the heading. The bearing being put out by the test set is displayed on the readouts to .01 degree.

3-9.1 No matter what the test set heading is, the heading can be instantly changed by depressing the switches or rotating the Bearing Wheel. The bearing change is also instant at the test set output with no settling time required.

3-10.1 Levels of the 30Hz Variable tone and 9960Hz FM tone can be varied from 0 to 60% modulation each with their respective controls. When taken out of the detent positions the respective UNCAL lamp will light. If more than 100% modulation is called for the OVER MOD lamp will come on.

3-11.1 Ident Tone - 1020Hz - will be off with the control in detent position on VOR. Rotating the control CW turns on the tone and it may be added from 0 to 60% modulation level also.

3-12.1 The Master Modulation Control will vary all modulation applied at particular time from zero to approximately twice normal levels - providing 100% mod is not exceeded.

3-13-.1 The Output Attenuator sets the RF level at the output connector and can vary the level from -6 to -120 dBm, or 112,000uV to .224uV. Refer to Figure 4-5 for a handy dB to volts and watts chart for levels to -100 dBm.

3-14.1 The VOR channels may be automatically selected by placing the AUTO/MANUAL switch to AUTO and rotating the channeling control CW until the desired rate is attained. If the starting frequency is 108.0, select 200 kHz on the channeling increment switch and every 200 kHz frequency will be selected up to 117.95 where the auto channeling will stop. Other frequencies and increments can be likewise selected.

3-15.1 For each frequency, the Phase LOCK lamp should be on. If not, probably the Variable Frequency control is not in the detent position.

3-16.1 If desired or required, another bearing clock frequency can be inserted at the Accessory Connector. Pin 8 must be grounded for external clock operation. The clock input must be TTL compatible (0-5V square wave).

3-17.1 The VOR Bearing can be verified to be within the specified ± .05 degrees by the following steps.

1. Select heading of 90°.
2. Select ZERO on the Meter Switch.
3. Allow the meter to center itself, or settle to no or little movement.
4. If the meter is not centered, operate the BEARING ZERO control to center the needle.

5. Switch the meter to BRG
6. Read the bearing error by using the lower meter scale. Each major division is .01 degrees; center is zero error. e.g. 10 would be - .04 degrees and 60 would be +.01 degrees.

3-18.1 LOC and GS Operation.

3-19.1 LOC and GS operation are very similar and differ only in frequencies used and modulation levels used. Therefore they will be explained together.

3-20.1 Select a LOC frequency on the Frequency Select Switches. Set the Channeling Rate Control full CCW. Set the LOC/GS switch to LOC.

3-21.1 If a proper LOC frequency was chosen the LOC Mode lamp will light. Set the 1020Hz and Master Mod controls to full CCW. Now each LOC tone (150Hz and 90Hz) will be modulating 20%. There will be no Ident 1020Hz tone present.

3-22.1 The LOC deviation is selected by the step-position DDM control. CCW rotation from zero gives left needle deflection on the receiver indicator, and CW rotation right deflection. The various DDM deviations are further explained in Figure 4-6, LOC and GS DDM correspondence chart.

3-23.1 If the DDM control is set to either the 150Hz or 90Hz position, that tone will be the only one present at 20% modulation while the other tone will be deleted. Should by some chance the GS control be set to one tone and the LOC control to the other tone, both tones will be deleted and neither would appear in the output.

3-24.1 Whenever a tone is deleted the corresponding warning lamp will light to guard against inadvertent wrong output test signals.

3-25.1 In the downward position the Variable DDM control is activated and controls the LOC deviation from zero to ± 0.4 DDM or twice the deflection the switch control gives. It is continuously variable from minus to plus .4 DDM.

3-26.1 LOC centering may be calibrated by setting the stepped position switch to 0 DDM. Set the meter switch to the 0-30% mod range. Using the GS stepped switch, delete the 90Hz tone by setting it to 150Hz. Read closely the modulation level of the 150Hz tone.

DELETE

3-27.1 Next delete the 150Hz tone by setting the GS control to 90Hz.

3-28.1 Read the level of the 90Hz tone. If it does not agree exactly with the level of the 150Hz tone, adjust the front panel LOC CAL control to achieve equal percentages of modulation for both tones.

3-29.1 The 1020Hz Ident tone may be added to the LOC output signal only by rotating the control clockwise from the detent position. The tone may be added 0-60% mod.

3-30.1 The relative phase of the 90 and 150Hz tones is fixed but may be temporarily changed by depressing the Ø switch located near the GS deviation switch. When depressed, the variation in phase of the 150Hz tone relative to the 90Hz tone is retarded at five times the angle selected by the VOR bearing selector, which can still be read out by the display. An indicated bearing of 2° would make the 150Hz tone lag the 90Hz tone by 10°, etc.

3-31.1 All the above information contained in paragraphs 3-21.1 through 3-30.1 applies equally to the GS tone controls. The LOC deviation switch is used to delete tones to set GS centering, etc.

3-32.1 The frequency in use determines the modulation selected - - LOC or GS. If the LOC-GS switch is in LOC all LOC frequencies selected will select LOC modulation. But in GS position the generator will change to RF output in the 330 MHz GS band and also select GS modulation. Auto or manual channeling can be used to select all available LOC and GS frequencies. GS frequencies may also be selected by directly selecting the GS frequency on the Frequency Select Switches. The display will indicate the actual output frequency in use.

3-33.1 A note about the generator output frequency which applies to VOR, LOC, GS, and COMM outputs. With the Variable Frequency Control full CCW the frequency is controlled by a phase-lock system referenced to a temperature-stabilized oscillator. Either the channeling system or frequency switch control the output.

3-34.1 When the Variable Frequency Control is rotated CW, the output can be deviated by approximately ± 50 kHz on all bands except GS where ± 150 kHz is available. Stability in the variable mode is excellent.

3-35.1 COMM Testing.

3-36.1 The generator covers all COMM frequencies from 118.00 through 135.975 MHz in one band, and from 136.00 to 156.00 MHz in another band. Frequencies may be selected in 25 kHz steps if required.

3-37.1 When using the automatic channeling mode the channeling will stop at 135.975 MHz. Then 136.00 MHz must be selected on the selector switches and the channeling will continue to 157.95 MHz and stop again.

3-38.1 The Ident Tone on COMM is on at a 30% mod level when the 1020Hz level control is in the detent position. The tone may be turned off by moving the control to the "0" position. From there the tone may again be added at a level from 0 to 60% mod.

3-39.1 For remote channeling of a receiver of any type using the 2 out of 5 select system, the .01 MHz, .1 MHz, 1 MHz and 10 MHz frequency channeling outputs are available at the Channeling Output connector on the rear panel. A wiring harness will have to be constructed for each receiver used.

3-40.1 The remote channeling follows whatever frequency is being displayed at any instant by the counter display.

3-41.1 The test set may be channeled from a remote source by an input from a section of automatic test equipment. For example, if receiver sensitivity over the range of a receiver's operating frequencies is to be checked, the following set-up can be used.

3-42.1 The receiver can be channeled from the NAV-750. Channeling should begin from the low end of the band of frequencies to be checked. The NAV-750 can be remotely advanced in channeling from a piece of ATC equipment which is checking for receiver output on each new frequency. The NAV-750 attenuator will be set to a minimum level desired to pass a sensitivity test. If a certain frequency of the receiver does not meet requirements, channeling may be stopped or the ATC will note on a printout the faulty frequency.

3-43.1 Other semi-automatic or automatic arrangements can be made depending on the users equipment to be used in testing with the NAV-750 as the "core" equipment.

3-44.1 On the rear panel, each of the modulating tones is present for use in other specialized receiver section tests. Often the sum of all tones output is used to check VOR bearing circuits directly without using the RF portion of the receiver.

SECTION IV

Theory of Operation

4-1. Introduction.

4-2. This section contains the circuit-theory of operation for IFR Model NAV-750 NAV-COMM Bench Test Set. Included is a general description, a block diagram desription, and individual description of circuits within the NAV-750 Test Set.

4-3. General Description of Test Set Operation.

4-4. The NAV-750 can be divided into several sections or groups which when studied individually can be more easily understood. Essentially each section can function independently of the others except the power supply, which is common to all other sections. The various sections are: 1) the VOR section, 2) the LOC and GS section, 3) the RF generator section, and 4) the Power Supply Section.

4-5. The VOR section is mainly located on PC-4 and PC-5. The bearing is selected on these boards, and the bearing oscillator is there. The two 30Hz signals, reference and variable, are applied to PC-2 where the square wave inputs are converted to sine waveforms, combined onto a 9960Hz signal and fed to PC-3.

4-6. On PC-3 the VOR tones are applied to controls to vary their modulation level. PC-3 also switches all modulation tones requred as determined by the RF frequency selected. The tones are then summed together and sent to the Mod/Amp assembly.

4-7. The VOR Bearing selected is displayed on a counter readout on the front panel. An RF DEMOD output is used to check the accuracy of the bearing at 90° and 270° by circuitry on PC-1.

4-8. The 90Hz and 150Hz tones are picked off the VOR bearing counter on PC-4 as square waves and are thus crystal-controlled in frequency and also controlled in phase relationship. The phase of the two signals is normally fixed but may be varied by shifting the 150Hz phase at a rate five times the selected VOR bearing.

4-9. The 90Hz and 150Hz square wave tones are applied from PC-4 to PC-5 where they are converted to sine waves. They are then combined at the front panel deviation switches, sent through the Tone Summation board, PC-3, and applied to the Mod/Amp assembly.

4-10. For COMM operation a 1020Hz tone oscillator on PC-2 is used as a test tone to modulate RF signals from 118.0 to 155 MHz. The 1020Hz tone is also used as an Ident signal on the VOR and LOC outputs.

4-11. The RF section consists of an oscillator controlled by a phase locked crystal reference system. The frequency is controlled by PC-6 where either a front panel set of frequency switches or internal counters controlled by a frequency channeling circuit select the desired output.

4-12. The selected frequency is translated into a 2 out of 5 select system on PC-7 which controls outputs at a rear panel connector to remotely channel a set being tested.

4-13. The RF from the Oscillator assembly is applied to the Mod-Amp, where modulation is imposed on the signal, then passed through an attenuator to the panel RF Output connector.

4-14. The Power section supplies six voltages of +5, +12, -12, +24, -18, and +170 volts relative to chassis as common ground. The 170 volts is used only for the HV gas discharge counter displays. The other four voltages are used generally throughout the NAV-750. The input to the power system is 115-240 VAC, 50Hz to 400Hz.

4-15. VOR Section.

4-16. Refer to the Simplified VOR Section Block Diagram, Fig 4- and to the schematics for PC-4 and PC-5, Fig 9-

4-17. The VOR bearing is referenced to a 2.16 MHz crystal oscillator on PC-4 using parts of X401 and X431. C401 sets the frequency precisely. If an external clock source is required, grounding pin J10-8 stops the osc. The ext input is applied at J10-9 and should be TTL compatible. (0-5V square wave)

4-18. X430 divides the 2.16 MHz to 1.08 MHz which is the frequency required for a .01° count. This frequency is applied to five counter stages to give bearing counts of .01, .1, 1, 10, and 100° steps. At a count representing 360° they are reset to zero, then begins to count up again.

4-19. At a count of 180°, a gate, X435B, senses the 80° output of the 10° counter, and the 100° output of the 100° counter. The gate output sets a FF, X429A, whose $\overline{Q}$ output forms the 30Hz Reference VOR signal. At 180° $\overline{Q}$ goes to a logic 0.

4-20. At 0° or 360° another gate senses 360° from appropriate counter outputs. This gate output operates O/S X436A which is used to give a wide reset pulse instead of the quick spike type pulse which would result if the gate output reset the counters directly.

4-21. O/S X436A does reset all the bearing counters to zero count, and also resets FF X429A. This causes $\overline{Q}$ to go high forming the other half of the 30Hz Reference signal. Therefore the reference signal is at a high level from 0° to 180°, and low from 180° to 0°.

4-22. As a by-product of the bearing counter, the 90Hz and 150Hz frequencies are derived from frequencies obtained from points in the counter. The output of the 1° decade counter is divided by twelve by X426 and the result is a 90Hz square wave. The counter is reset at the same time as the bearing counter by X436A.

4-23. The output of the .1° counter is divided by 72 to obtain 150Hz. Reset to the ÷ 72 counter is applied from one of two sources. The first source is the "normal" one and is the O/S X436A. This resets X433 and X434, the ÷ 72 unit, coincident with the bearing counter. The second reset source is the 30Hz VAR square output from FF X402. This shifts the phase of the 150Hz signal relative to the 90Hz signal in increments equal to five times the VOR selected bearing. Depressing the front panel "Ø" (phase) switch changes the reset source.

4-24. The VOR Bearing is selected by the remainder of the circuitry on PC-4 and PC-5. A programmable, up-down counter is run "parallel" to the above described bearing counter and contains stages for .01, .1, 1, 10, and 100 degree steps. The up-down counter is connected to the bearing counter through five comparator IC's, one for each counter stage. If the counts in the two counters are exactly equal, the comparator outputs all enable a set of gates (X430, X412A, X408D, X415B, X408E) to achieve a logic 0 at the output of X415B. At all other times X415B's output is high.

4-25. Assume the up-down counter has a bearing of 275° stored in it. Operation of the up-down counter will be explained later. As the bearing counter counts up from zero degrees the comparators continously compare the counts in the two parallel counters. At 275° equality is sensed and X415B's output changes to a low state. This causes FF's X430 and X402 to "set".

4-26. The FF setting causes Q output of X402B to go high and forms the positive-half of the 20Hz variable square output. Q going high also enables gate X431C which allows .01 degree pulses from X430A to be counted by a 180° counter consisting of X402, X403, X404, X405, and X406. At the accumulated count of 180° gate X401A is enabled and in turn resets FF X402B. The FF resetting causes Q output to go low, forming the last half of the 30Hz VAR square output signal.

4-27. The result of the variable square circuit is that at the selected bearing the output goes high, and is high for 180° when it goes low until the selected bearing appears at the comparator output again (180° later).

4-28. The 30Hz Variable signal described forms the "TO" output. The "FROM" output is taken from the $\overline{Q}$ output FF X402B, and is 180° out of phase with the "TO" signal. Which signal is used is selected by the front panel TO-FROM switch.

4-29. The programmed up-down counter is operated by two sources. One is a set of gating logic on PC-5 in turn operated by the 12 cardinal bearing switches on the front panel. Depressing any switch causes that particular bearing to be loaded into the up-down counter.

4-30. Whenever any bearing switch is depressed either gate X5002 or gate X5001 is disabled and through other gates causes the Load Line to go low. While the load input is low, data present at the preset inputs of the up-down counter sets the counter to correspond to that data. When any switch is activated the .01, .1, and 1 degree counters are preset to zero.

4-31. Gate X5003 always causes a bearing of 10° to be preset. X5004 always causes 20° to be preset. X5005A always causes 40° to be preset. X5005B always causes 80° to be preset. The above gates all operate on counter X413, the 10° counter. Combinations of inputs can cause any heading of 10 to 90° to be preset into X413.

4-32. X5007 always causes 100° to be preset, and X5006 always causes 200° to be preset. These two gates operate into X414, the 100° counter. Both applied together cause 300° to be preset.

4-33. When the NAV-750 is first turned on, a system normalizer causes the same reaction as depressing the 0° switch, and initally sets the up-down counter to zero bearing. The normalizer consists of X5008B and associated circuitry.

4-34. Two additional pushbutton switches allow bearing changes of +10 and -10 degrees to be made to any bearing present in the up-down counter.

If the -10° switch is depressed, X5011B is disabled and the output goes high. The output of this gate controls the up-down control line of the counter. If the line is hig the counter will count down; conversely, if the line is low the counter will count up. Thus the -10° switch causes the counter to be able to count down.

4-35. Depressing the +10° switch disables gate X5011C, causing it's output to go high and enable gate X5011B, causing it's output to go low. Thus the counter is set to count up.

4-36. The actual clock pulse causing the +10 or -10 degree count change comes from O/S X5012B. It is set through either diode CR5002 or CR5003. It operates the Schmitt Trigger X5010D and X5010E which applies one clock pulse to X413 and advances or retards the counter one count (equal to 10°). By the way the total up-down counter is connected, if X413 is at zero bearing and -10° is called for, the entire counter will retard by a 10° step. This may mean going from, for example, 5.72 degrees (-10°) to 355.72 degrees.

4-37. The second way to change count in the up-down counter to determine the VOR Bearing is by the Bearing knob on the front panel which alters the bearing in either .01 or .05 degree steps with each 1/40 revolution. The control consists of a 40-tooth gear whose teeth break the light path of two transducers. As the path is broken the transducer output goes high. One transducer is used as a clock source, the other as a direction of knob rotation sensor.

4-38. As the gear teeth break the ligh path, pulses are formed by X5013 and inverted by X5008C to form clock pulses. These are applied to O/S X5012A and to gate X5019B.

4-39. A front panel switch selects whether .01 or .05 degree increments are to be selected. If .01 degrees is desired, X5019 selects clock pulses before O/S X5012A. If .05 degree increments are to be selected, X5019 selects clock pulses from a UJT oscillator. O/S X5012A enables the UJT oscillator to operate in pulse groups of five as set by pot R5091.

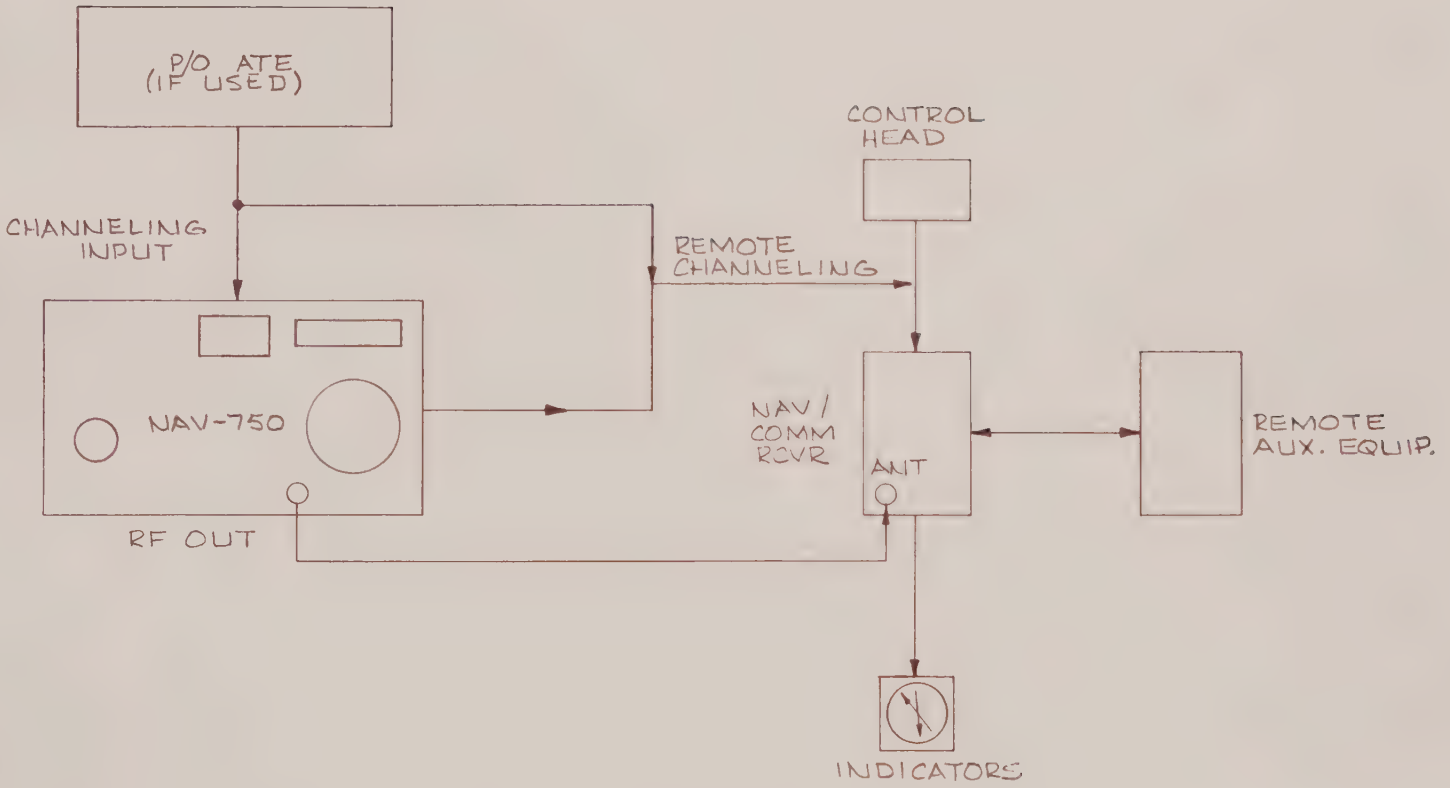
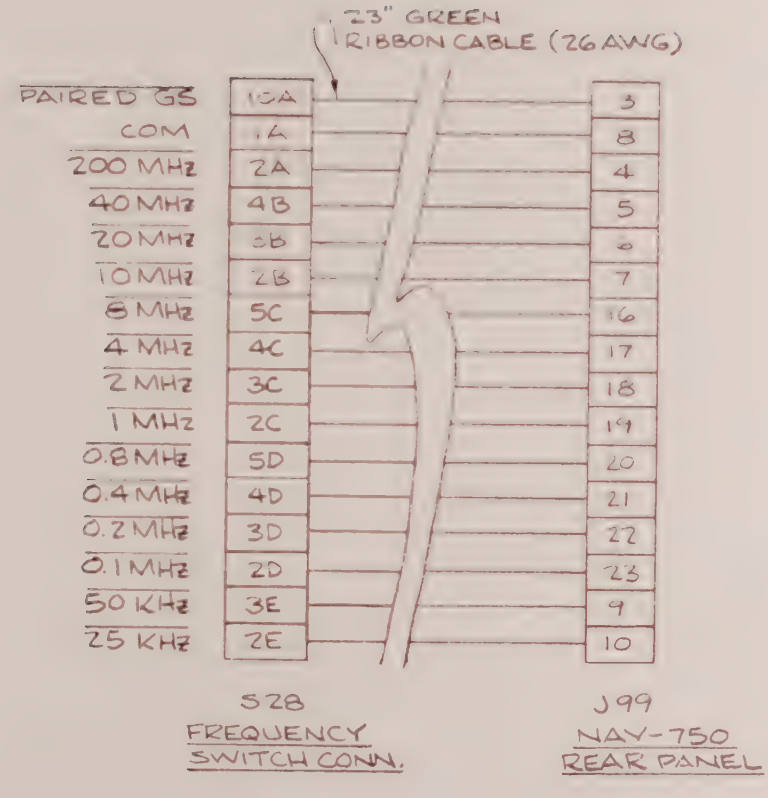


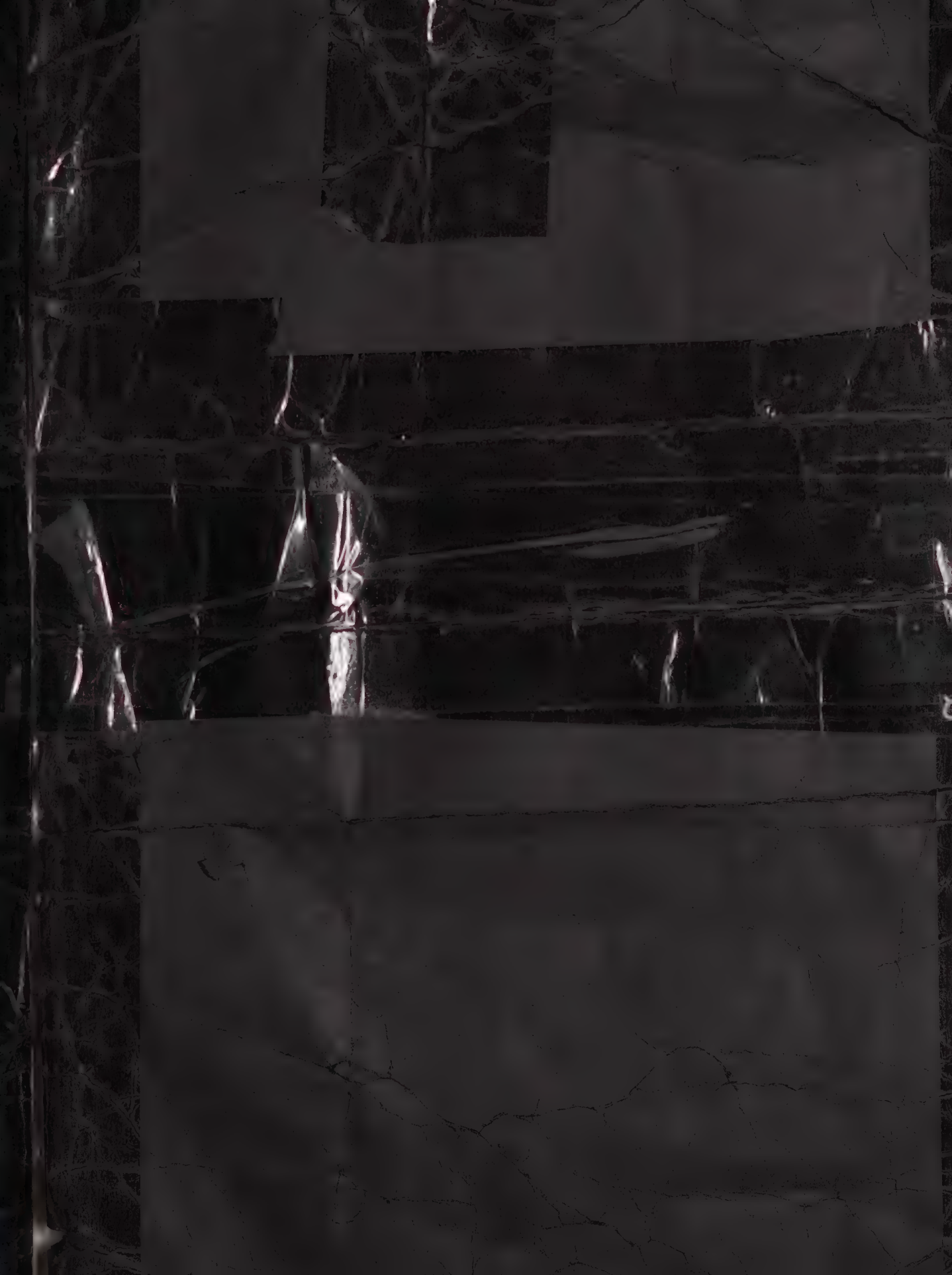
FIG 4-1
CONNECTIONS FOR VOR,
LOC, G/S OR COMM REC.

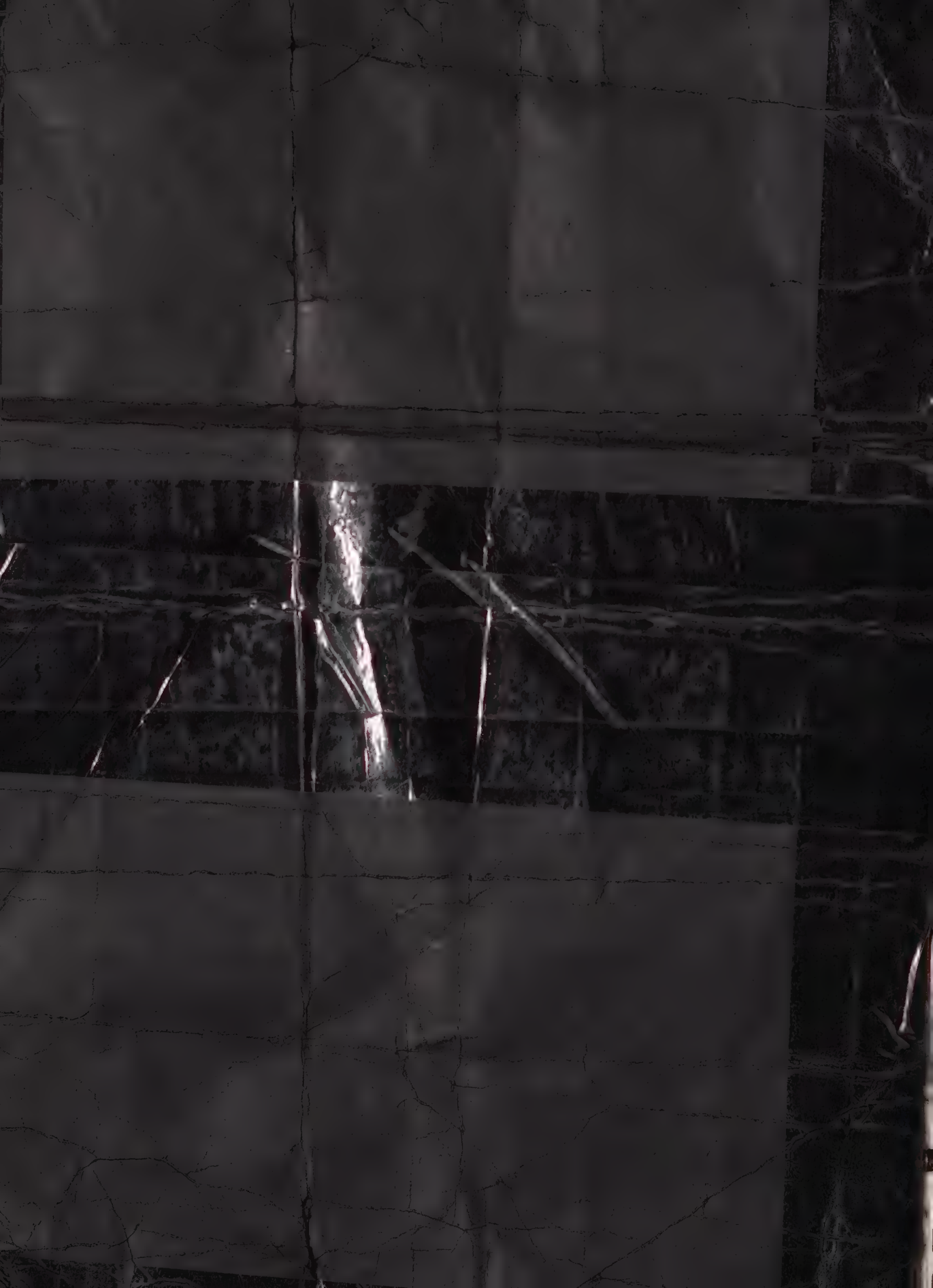


PIN CONNECTIONS FOR REMOTE FREQUENCY
PROGRAMMING OPTION NAV-750A

	0	1	2	3	4	5	6	7	8	9
			25			50		75		
A		X	X						X	X
B	X	X		X	X					
C			X	X		X	X			
D					X	X		X	X	
E	X						X	X		X

FREQUENCY SELECTOR TWO-OUT-OF-FIVE BINARY CODE





DATE	REV	CHANGE	APP'D

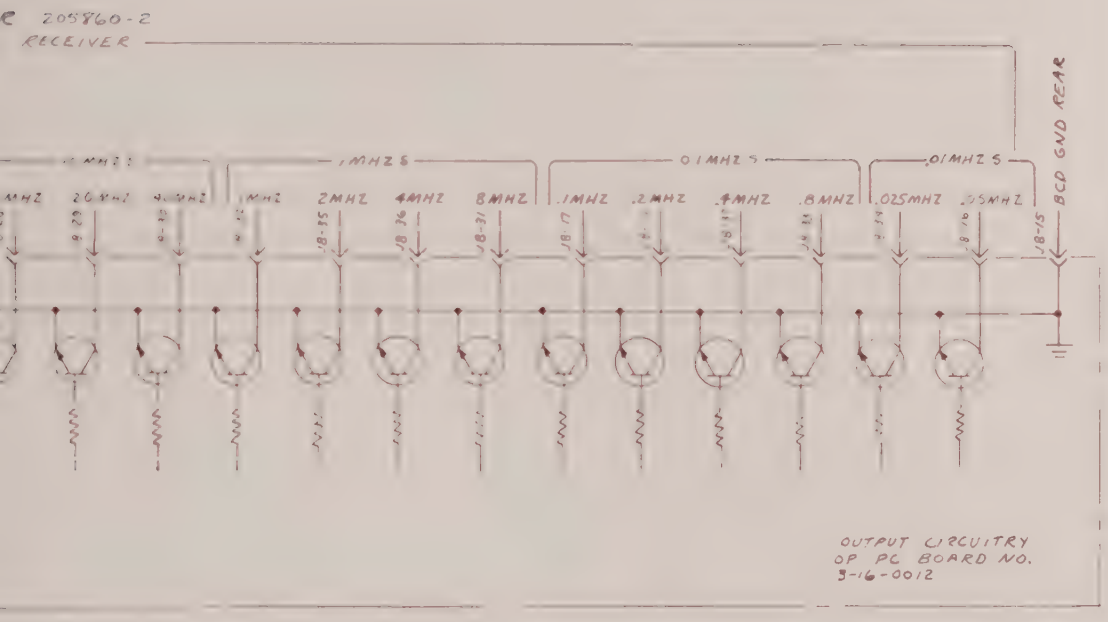


FIG. 4-2

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
		NAV-750				

APPLICATION

LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 ▽
REMOVE ALL BURR

DRAWN JIG 5/9/73
CHECKED
APPROVED 1-17-74

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: EXT CONNECTION TO REMOTE CHANNELING BD. NAV-750

MATERIAL
TREATMENT
FINISH

SIZE C | PART NUMBER 3-16-0068 | REV

SCALE | WEIGHT | SHEET OF

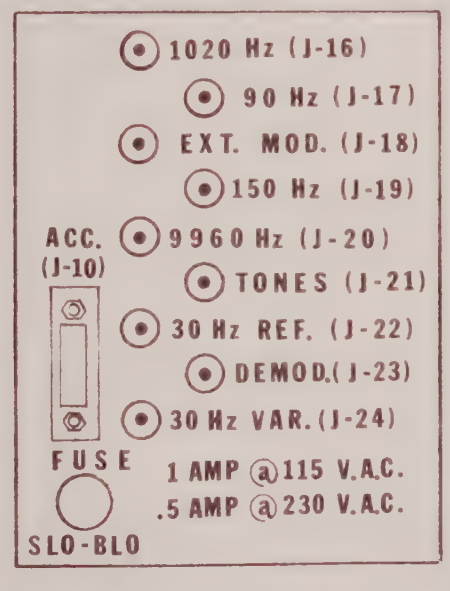


Figure 4-3

List of Connections for Accessory Connector-J10

Pin	Function
1	+24 Volts Regulated Output
2	+12 Volts Regulated Output
3	+5 Volts Regulated Output
4	Ground
5	-12 Volts Regulated Output
6	Remote Channeling Input
7	Ground
8	Ground for external Clock Select
9	External Bearing Clock Input
10	1020Hz Tone Output
11	External Modulation Input
12	End of Channeling
13	NC
14	NC
15	NC
16	NC

FIG. 4-3

Figure 4-4

Correspondence Chart for dB, Volts, Watts into a 50 Ohm Load

dBw - Decibels referenced to one watt
dBm - Decibels referenced to one milliwatt
V - Volts
mV - Millivolts (volts x 10 -3)
uV - Microvolts (volts x 10 -6)
W - Watts
mW - Milliwatts (watts x 10 -3)
uW - Microwatts (watts x 10 -6)
nW - Nanowatts (watts x 10 -9)
pW - Picowatts (watts x 10 -12)
aW - Attowatts (watts x 10 -18)

+40 dBw	709V	10,000W
+39 dBw	633V	7,940W
+38 dBw	563V	6,320W
+37 dBw	501V	5,000W
+36 dBw	447V	3,980W
+35 dBw	399V	3,160W
+34 dBw	355V	2,510W
+33 dBw	317V	2,000W
+32 dBw	282V	1,590W
+31 dBw	252V	1,260W
+30 dBw	224V	1,000W
+29 dBw	200V	794W
+28 dBw	178V	632W
+27 dBw	159V	500W
+26 dBw	141V	398W
+25 dBw	126V	316W
+24 dBw	112V	251W
+23 dBw	100V	200W
+22 dBw	89.1V	159W
+21 dBw	79.5V	126W
+20 dBw	70.9V	100W
+19 dBw	63.3V	79.4W
+18 dBw	56.3V	63.2W
+17 dBw	50.1V	50.0W
+16 dBw	44.7V	39.8W
+15 dBw	39.9V	31.6W
+14 dBw	35.5V	25.1W
+13 dBw	31.7V	20.0W
+12 dBw	28.2V	15.9W
+11 dBw	25.2V	12.6W

+10 dBw = +40 dBm	22.4V	10.0W
+ 9 dBw	20.0V	7.94W
+ 8 dBw	17.8V	6.32W
+ 7 dBw	15.9V	5.00W
+ 6 dBw	14.1V	3.98W
+ 5 dBw	12.6V	3.16W
+ 4 dBw	11.2V	2.51W
+ 3 dBw	10.0V	2.00W
+ 2 dBw	8.91V	1.59W
+ 1 dBw = +31 dBm	7.95V	1.26W
0 dBw = +30 dBm	7.09V	1.00W = 1000mW
+30 dBm = 0 dBw	7.09V	1000mW = 1W
+29 dBm	6.33V	794mW
+28 dBm	5.63V	632mW
+27 dBm	5.01V	500mW
+26 dBm	4.47V	398mW
+25 dBm	3.99V	316mW
+24 dBm	3.55V	251mW
+23 dBm	3.17V	200mW
+22 dBm	2.82V	159mW
+21 dBm	2.52V	126mW
+20 dBm	2.24V	100mW
+19 dBm	2.00V	79.4mW
+18 dBm	1.78V	63.2mW
+17 dBm	1.59V	50.0mW
+16 dBm	1.41V	39.8mW
+15 dBm	1.26V	31.6mW
+14 dBm	1.12V	25.1mW
+13 dBm	1.00V = 1000mV	20.0mW
+12 dBm	891mV	15.9mW
+11 dBm	795mV	12.6mW
+10 dBm	709mV	10.0mW = .01W
+ 9 dBm	633mV	7.94mW
+ 8 dBm	563mV	6.32mW
+ 7 dBm	501mV	5.00mW
+ 6 dBm	447mV	3.98mW
+ 5 dBm	399mV	3.16mW
+ 4 dBm	355mV	2.51mW
+ 3 dBm	317mV	2.00mW
+ 2 dBm	282mV	1.59mW
+ 1 dBm	252mV	1.26mW
0 dBm	224mV = 224,000uV	1.00mW = 1000uW
- 1 dBm	200,000uV	794uW
- 2 dBm	178,000uV	632uW
- 3 dBm	159,000uV	500uW
- 4 dBm	141,000uV	398uW
- 5 dBm	126,000uV	316uW
- 6 dBm	112,000uV	251uW
- 7 dBm	100,000uV	200uW
- 8 dBm	89,100uV	159uW
- 9 dBm	79,500uV	126uW
-10 dBm	70,900uV	100uW

-10 dBm	70,900uV	100uW
-11 dBm	63,300uV	79.4uW
-12 dBm	56,300uV	63.2uW
-13 dBm	50,100uV	50.0uW
-14 dBm	44,700uV	39.8uW
-15 dBm	39,900uV	31.6uW
-16 dBm	35,500uV	25.1uW
-17 dBm	31,700uV	20.0uW
-18 dBm	28,200uV	15.9uW
-19 dBm	25,200uV	12.6uW
-20 dBm	22,400uV	10.0uW
-21 dBm	20,000uV	7.94uW
-22 dBm	17,800uV	6.32uW
-23 dBm	15,900uV	5.00uW
-24 dBm	14,100uV	3.98uW
-25 dBm	12,600uV	3.16uW
-26 dBm	11,200uV	2.51uW
-27 dBm	10,000uV	2.00uW
-28 dBm	8,900uV	1.59uW
-29 dBm	7,950uV	1.26uW
-30 dBm	7,090uV	1.00uW
-31 dBm	6,330uV	.794uW
-32 dBm	5,630uV	.632uW
-33 dBm	5,010uV	.500uW
-34 dBm	4,470uV	.398uW
-35 dBm	3,990uV	.316uW
-36 dBm	3,550uV	.251uW
-37 dBm	3,170uV	.200uW
-38 dBm	2,820uV	.159uW
-39 dBm	2,520uV	.126uW
-40 dBm	2,240uV	.100uW = 100nW
-41 dBm	2,000uV	79.4nW
-42 dBm	1,780uV	63.2nW
-43 dBm	1,590uV	50.0nW
-44 dBm	1,410uV	39.8nW
-45 dBm	1,260uV	31.6nW
-46 dBm	1,120uV	25.1nW
-47 dBm	1,000uV	20.0nW
-48 dBm	891uV	15.9nW
-49 dBm	795uV	12.6nW
-50 dBm	709uV	10.0nW
-51 dBm	633uV	7.94nW
-52 dBm	563uV	6.32nW
-53 dBm	501uV	5.00nW
-54 dBm	447uV	3.98nW
-55 dBm	399uV	3.16nW
-56 dBm	355uV	2.51nW
-57 dBm	317uV	2.00nW
-58 dBm	282uV	1.59nW
-59 dBm	252uV	1.26nW

-60 dBm	224uV	1.00nW
-61 dBm	200uV	0.794nW
-62 dBm	178uV	0.632nW
-63 dBm	159uV	0.500nW
-64 dBm	141uV	0.398nW
-65 dBm	126uV	0.316nW
-66 dBm	112uV	0.251nW
-67 dBm	100uV	0.200nW
-68 dBm	89.1uV	0.159nW
-69 dBm	79.5uV	0.126nW
-70 dBm	70.9uV	0.100nW = 100pW
-70 dBm	70.9uV	100pW
-71 dBm	63.3uV	79.4pW
-72 dBm	56.3uV	63.2pW
-73 dBm	50.1uV	50.0pW
-74 dBm	44.7uV	39.8pW
-75 dBm	39.9uV	31.6pW
-76 dBm	35.5uV	25.1pW
-77 dBm	31.7uV	20.0pW
-78 dBm	28.2uV	15.9pW
-79 dBm	25.2uV	12.6pW
-80 dBm	22.4uV	10.0pW
-81 dBm	20.0uV	7.94pW
-82 dBm	17.8uV	6.32pW
-83 dBm	15.9uV	5.00pW
-84 dBm	14.1uV	3.98pW
-85 dBm	12.6uV	3.16pW
-86 dBm	11.2uV	2.51pW
-87 dBm	10.0uV	2.00pW
-88 dBm	8.91uV	1.59pW
-89 dBn	7.95uV	1.26pW
-90 dBm	7.09uV	1.00pW
-91 dBm	6.33uV	0.794pW
-92 dBm	5.63uV	0.632pW
-93 dBm	5.01uV	0.500pW
-94 dBm	4.47uV	0.398pW
-95 dBm	3.99uV	0.316pW
-96 dBm	3.55uV	0.251pW
-97 dBm	3.17uV	0.200pW
-98 dBm	2.82uV	0.159pW
-99 dBm	2.52uV	0.126pW
-100 dBm	2.24uV	0.100pW

-100 dBm	2.24uV	0.100pW
-101 dBm	2.00uV	0.0794pW
-102 dBm	1.78uV	0.0632pW
-103 dBm	1.59uV	0.0500pW
-104 dBm	1.41uV	0.0398pW
-105 dBm	1.26uV	0.0216pW
-106 dBm	1.12uV	0.0251pW
-107 dBm	1.00uV	0.0200pW
-108 dBm	0.891uV	0.0159pW
-109 dBm	0.795uV	0.0126pW
-110 dBm	0.709uV	0.0100pW = 10,000aW
-111 dBm	0.633uV	7,940aW
-112 dBm	0.563uV	6,320aW
-113 dBm	0.501uV	5,000aW
-114 dBm	0.447uV	3,980aW
-115 dBm	0.399uV	3,160aW
-116 dBm	0.355uV	2,510aW
-117 dBm	0.317uV	2,000aW
-118 dBm	0.282uV	1,590aW
-119 dBm	0.252uV	1,260aW
-120 dBm	0.224uV	1,000aW
-121 dBm	0.200uV	794aW
-122 dBm	0.178uV	632aW
-123 dBm	0.159uV	500aW
-124 dBm	0.141uV	398aW
-125 dBm	0.126uV	316aW
-126 dBm	0.112uV	251aW
-127 dBm	0.100uV	200aW
-128 dBm	0.0891uV	159aW
-129 dBm	0.0795uV	126aW
-130 dBm	0.0709uV	100aW
-131 dBm	0.0633uV	79.4aW
-132 dBm	0.0563uV	63.2aW
-133 dBm	0.0501uV	50.0aW
-134 dBm	0.0447uV	39.8aW
-135 dBm	0.0399uV	31.6aW
-136 dBm	0.0355uV	25.1aW
-137 dBm	0.0317uV	20.0aW
-138 dBm	0.0282uV	15.9aW
-139 dBm	0.0252uV	12.6aW
-140 dBm	0.0224uV	10.0aW

Figure 4-5

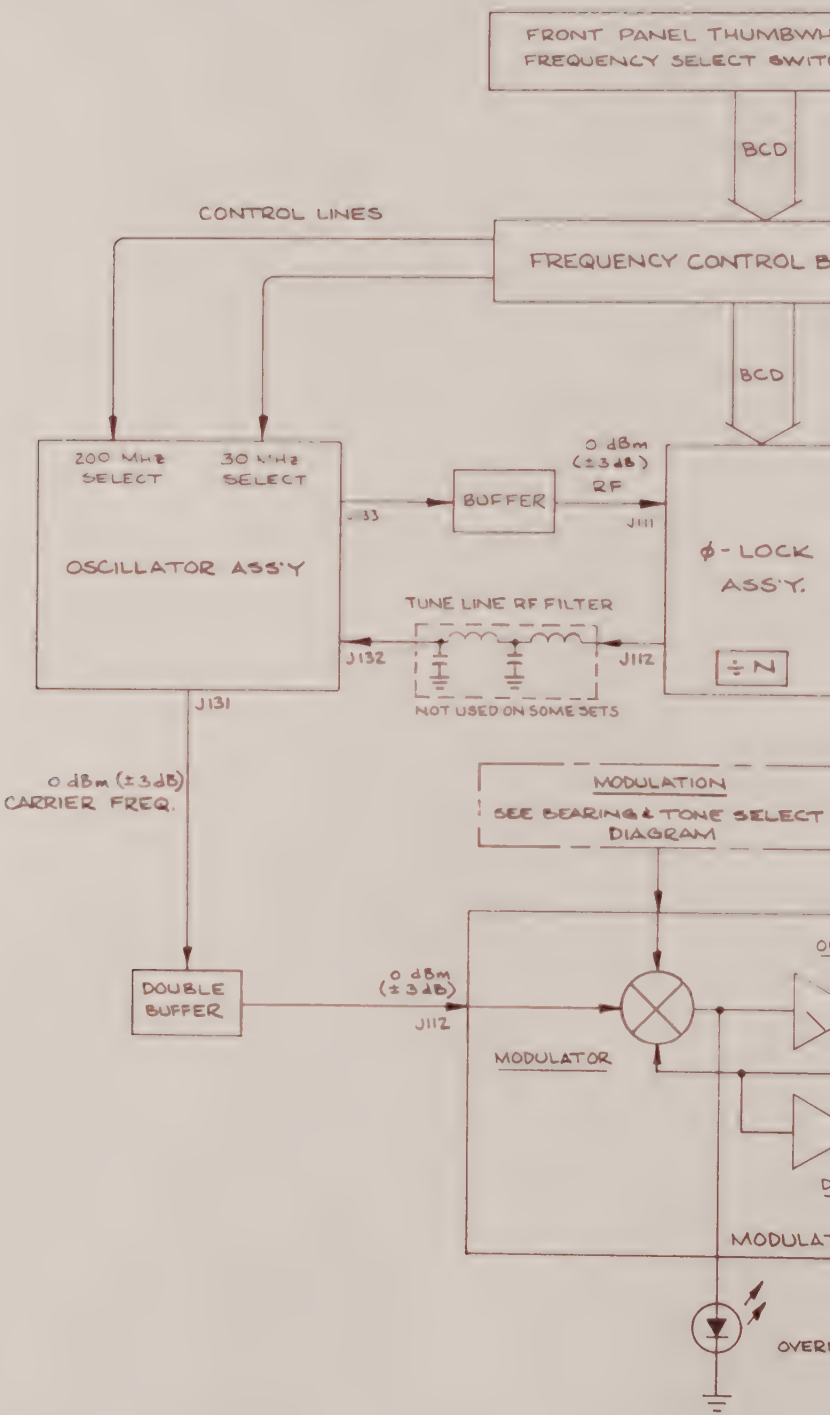
Correspondence Chart for 90 and 150Hz Tones

LOC

	DDM	dB	Micro Amps	% Modulations
Centered	0	0	0	20,20
Standard Deflection	.093	4.114	90	15.35,24.65
Full Scale Deflection	.155	7.102	150	12.25,27.75
More than Full Scale	.200	9.542	194	10.00,30.00
Full One Tone, Delete Other	.4	Infinity	387	0.00,40.00

GS

Centered	0	0	0	40,40
Standard Deflection	.091	1.988	78	35.45,44.55
Full Scale Deflection	.175	3.682	150	31.25,48.75
More than Full Scale	.400	9.542	343	20.00,60.00
Full One Tone, Delete Other	.800	Infinity	686	0.00,80.00


FRONT PANEL THUMBWH
FREQUENCY SELECT SWITC
BCD
CONTROL LINES
FREQUENCY CONTROL B
BCD
200 MHz SELECT
30 MHz SELECT
OSCILLATOR ASS'Y
J133
BUFFER
0 dBm (±3dB) RF
J111
ϕ-LOCK ASS'Y.
÷N
TUNE LINE RF FILTER
J132
J112
NOT USED ON SOME SETS
J131
0 dBm (±3dB) CARRIER FREQ.
MODULATION
SEE BEARING & TONE SELECT DIAGRAM
DOUBLE BUFFER
0 dBm (±3dB)
J112
MODULATOR
MODULA
OVER

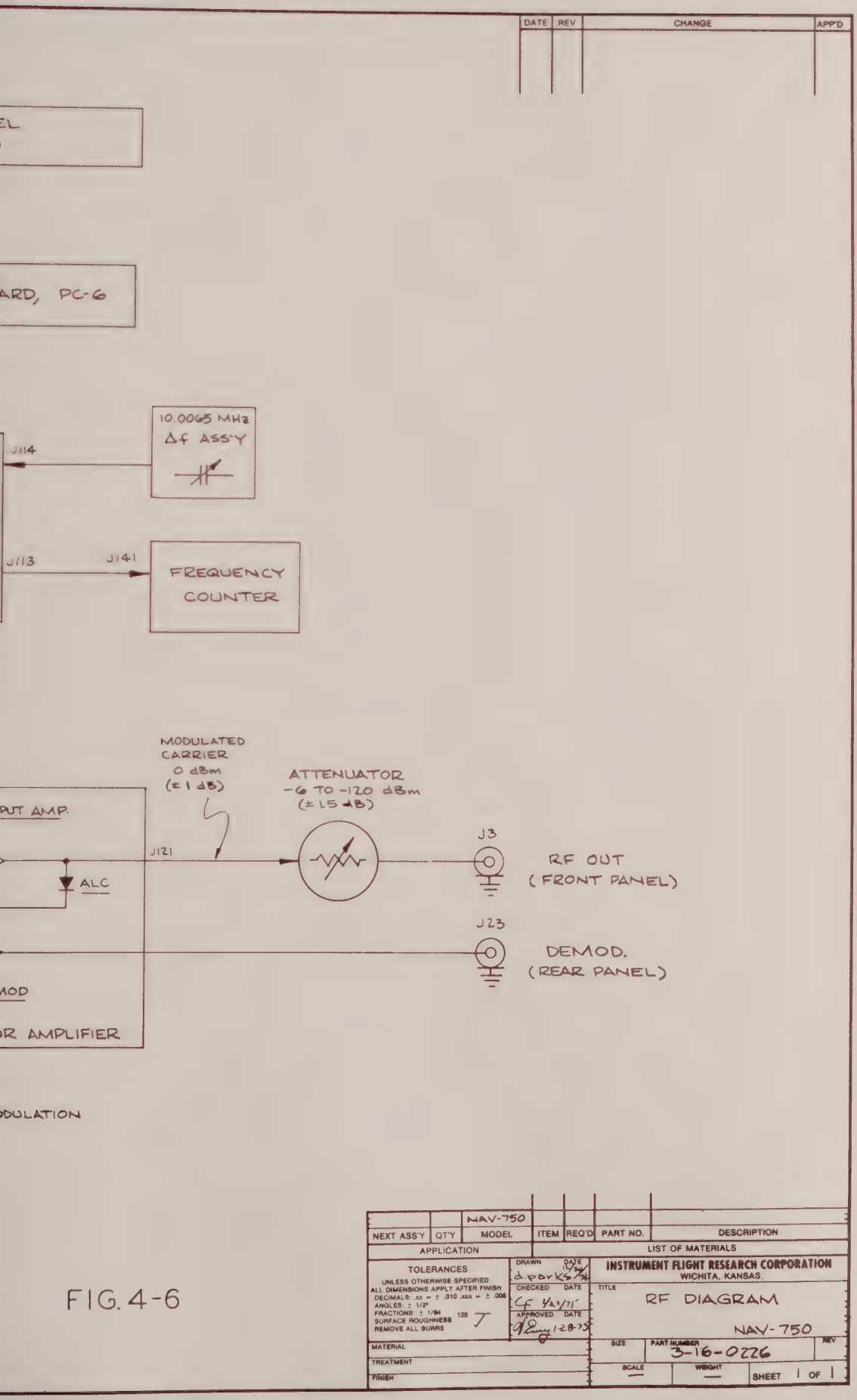
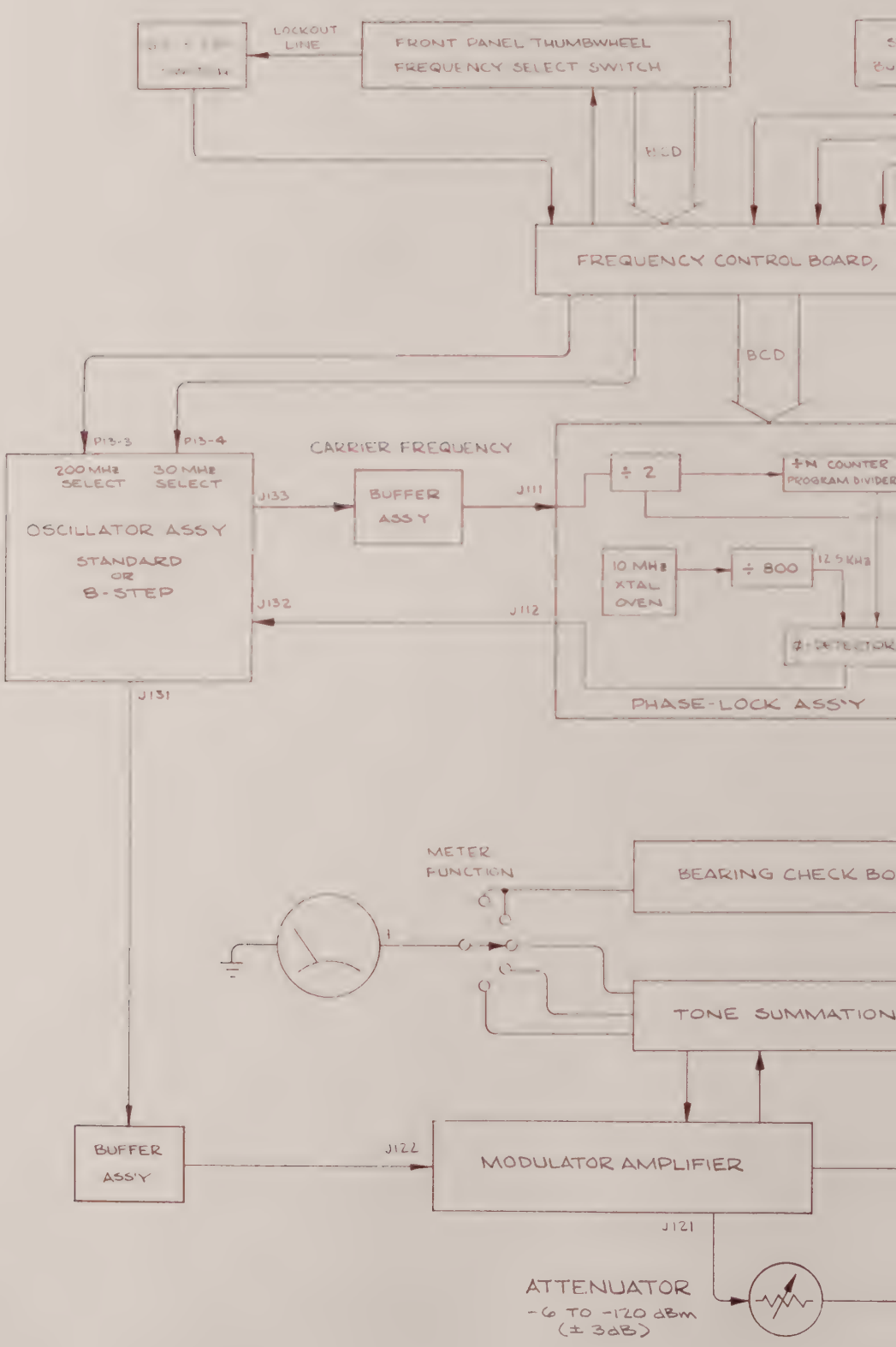
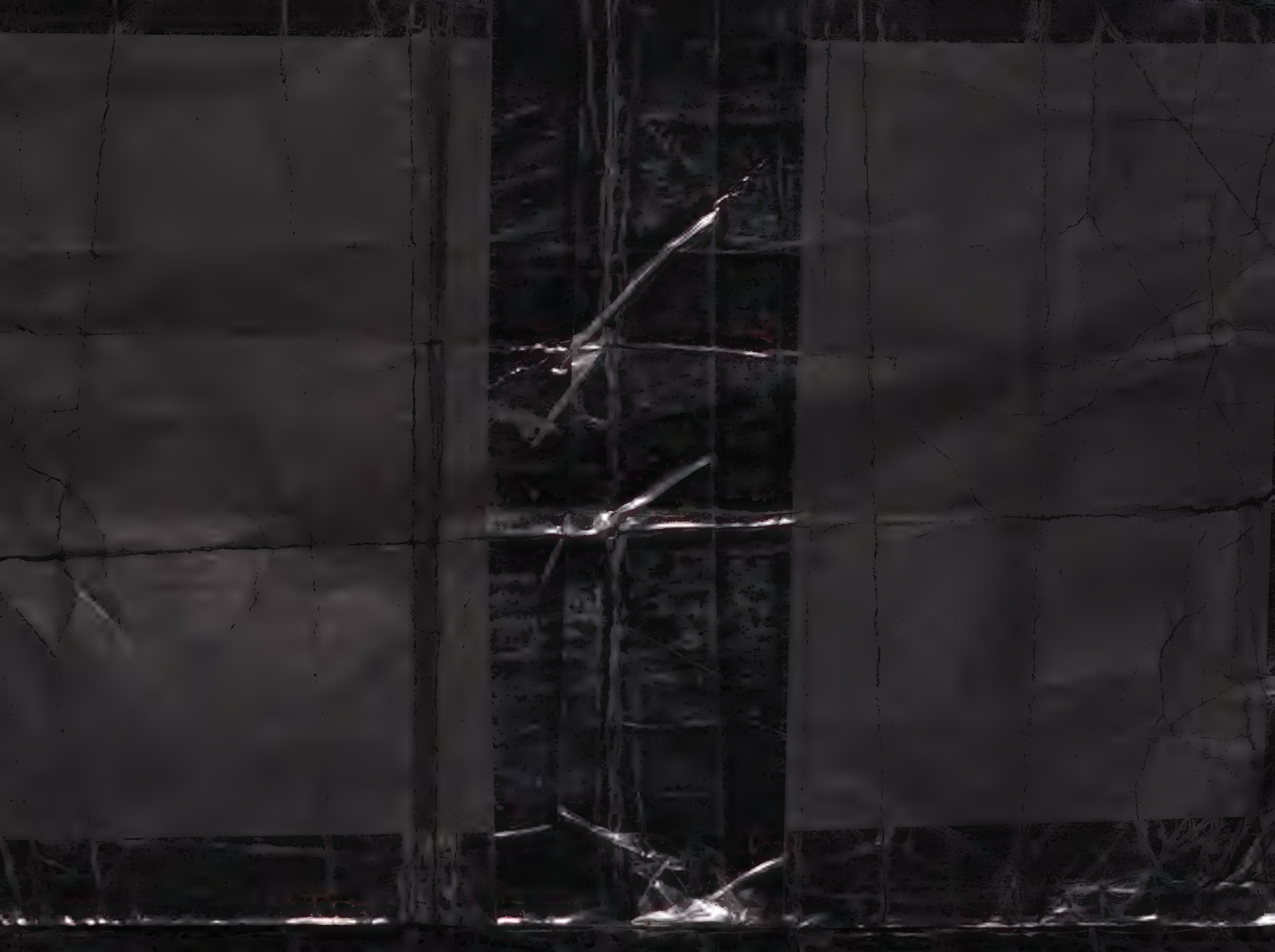

DATE
REV
CHANGE
APP'D
EL
ARD, PC-6
10.0065 MHz
Δf ASS'Y
J114
J113
J141
FREQUENCY
COUNTER
MODULATED
CARRIER
0 dBm
(± 1 dB)
ATTENUATOR
-6 TO -120 dBm
(± 1.5 dB)
PUT AMP.
J121
ALC
J3
RF OUT
(FRONT PANEL)
J23
DEMOD.
(REAR PANEL)
MOD
R AMPLIFIER
DULATION
NAV-750
NEXT ASS'Y
QT'Y
MODEL
ITEM
REQ'D
PART NO.
DESCRIPTION
APPLICATION
LIST OF MATERIALS
TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .XX = ± .010 .XXX = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS
DRAWN
DATE
d. parks
CHECKED
DATE
CF 4/23/75
APPROVED
DATE
1-28-75
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.
TITLE
RF DIAGRAM
NAV-750
MATERIAL
TREATMENT
FINISH
SIZE
PART NUMBER
3-16-0226
REV
SCALE
WEIGHT
SHEET 1 OF 1

FIG. 4-6


LOCKOUT LINE
FRONT PANEL THUMBWHEEL FREQUENCY SELECT SWITCH
BCD
FREQUENCY CONTROL BOARD,
BCD
P13-3
P13-4
200 MHz SELECT
30 MHz SELECT
OSCILLATOR ASS'Y
STANDARD OR 8-STEP
CARRIER FREQUENCY
J133
BUFFER ASS'Y
J111
÷ 2
÷N COUNTER PROGRAM DIVIDER
10 MHz XTAL OVEN
÷ 800
12.5 KHz
J132
J112
PHASE-LOCK ASS'Y
J131
METER FUNCTION
BEARING CHECK BO
TONE SUMMATION
BUFFER ASS'Y
J122
MODULATOR AMPLIFIER
J121
ATTENUATOR
-6 TO -120 dBm
(± 3dB)



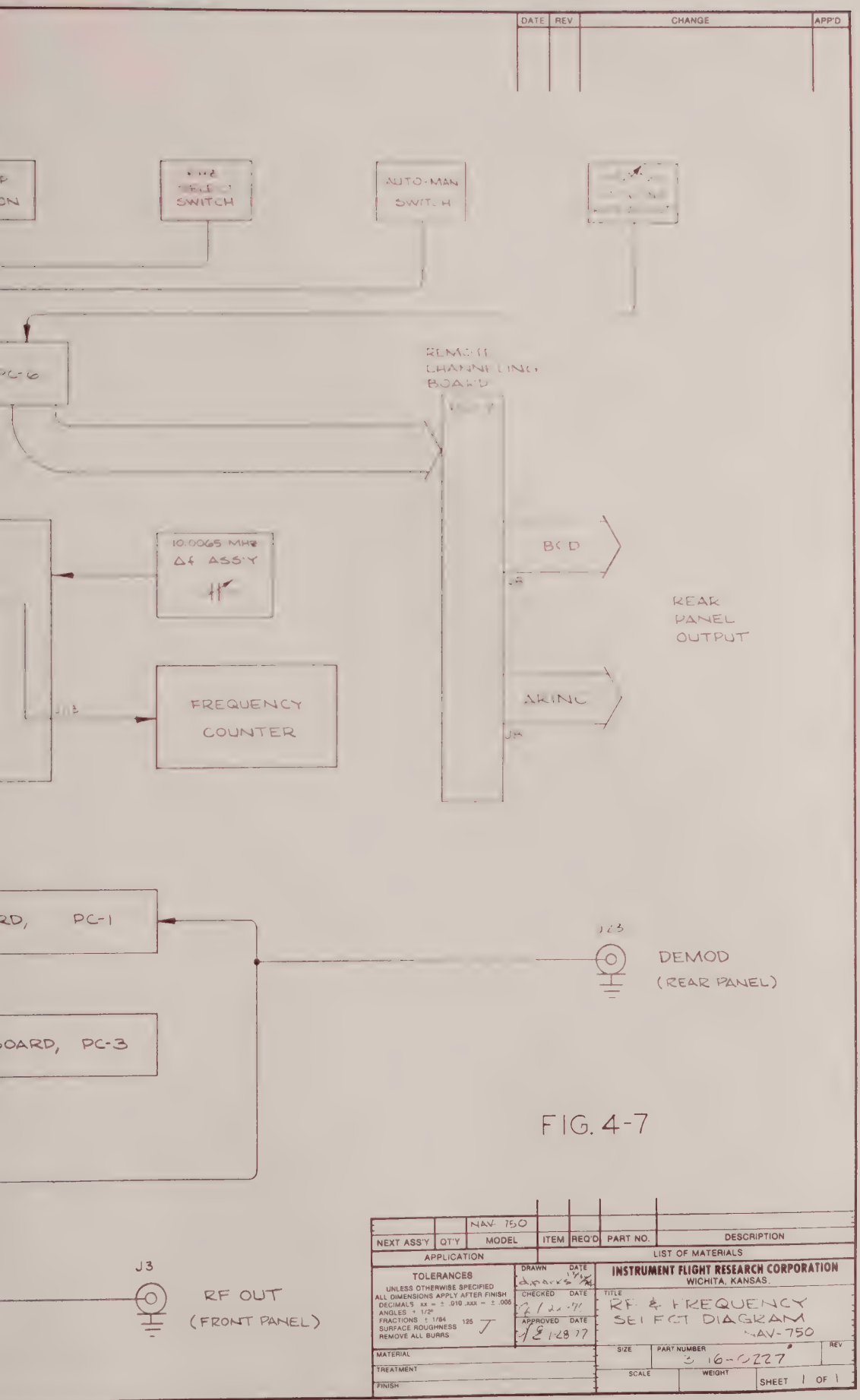
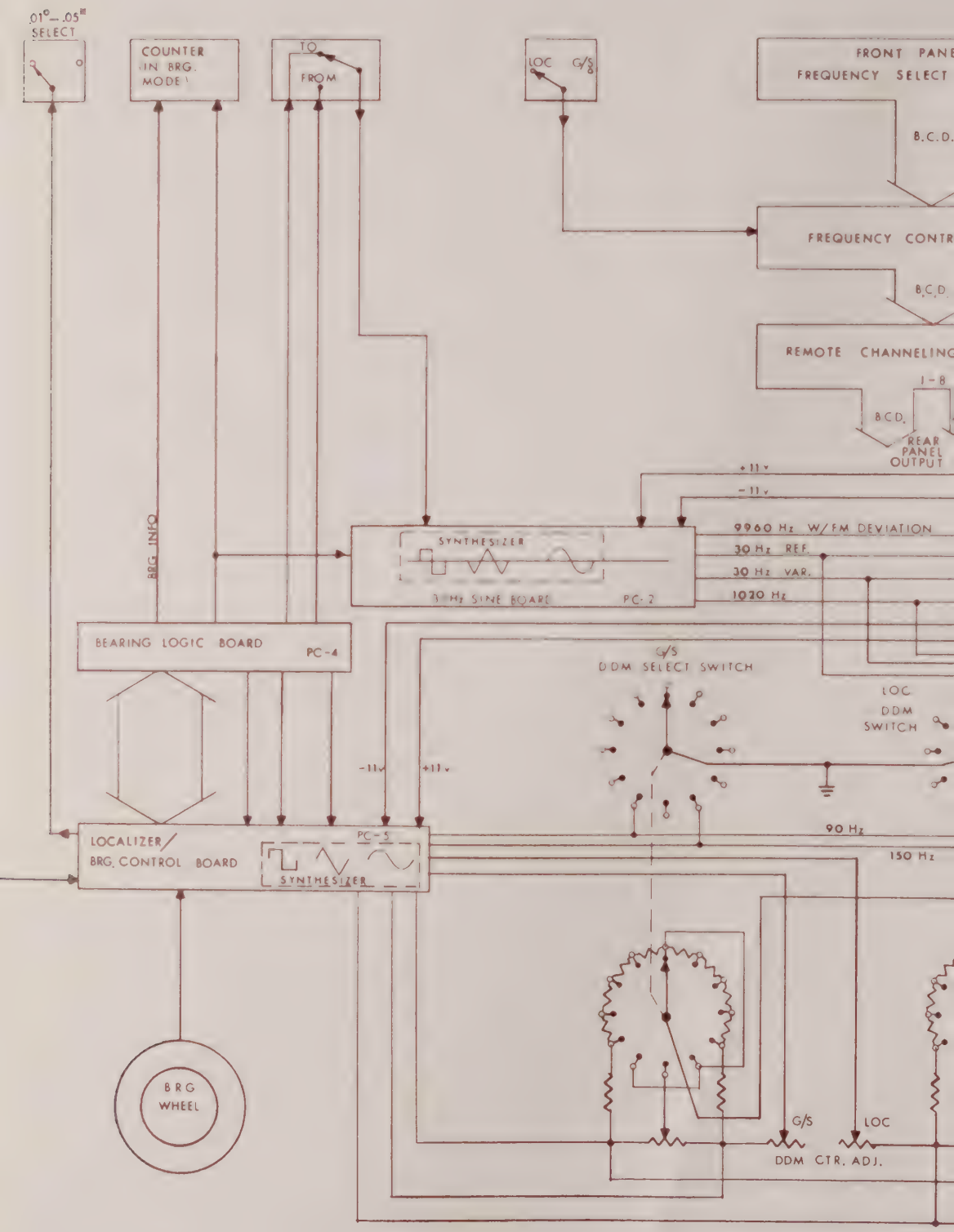
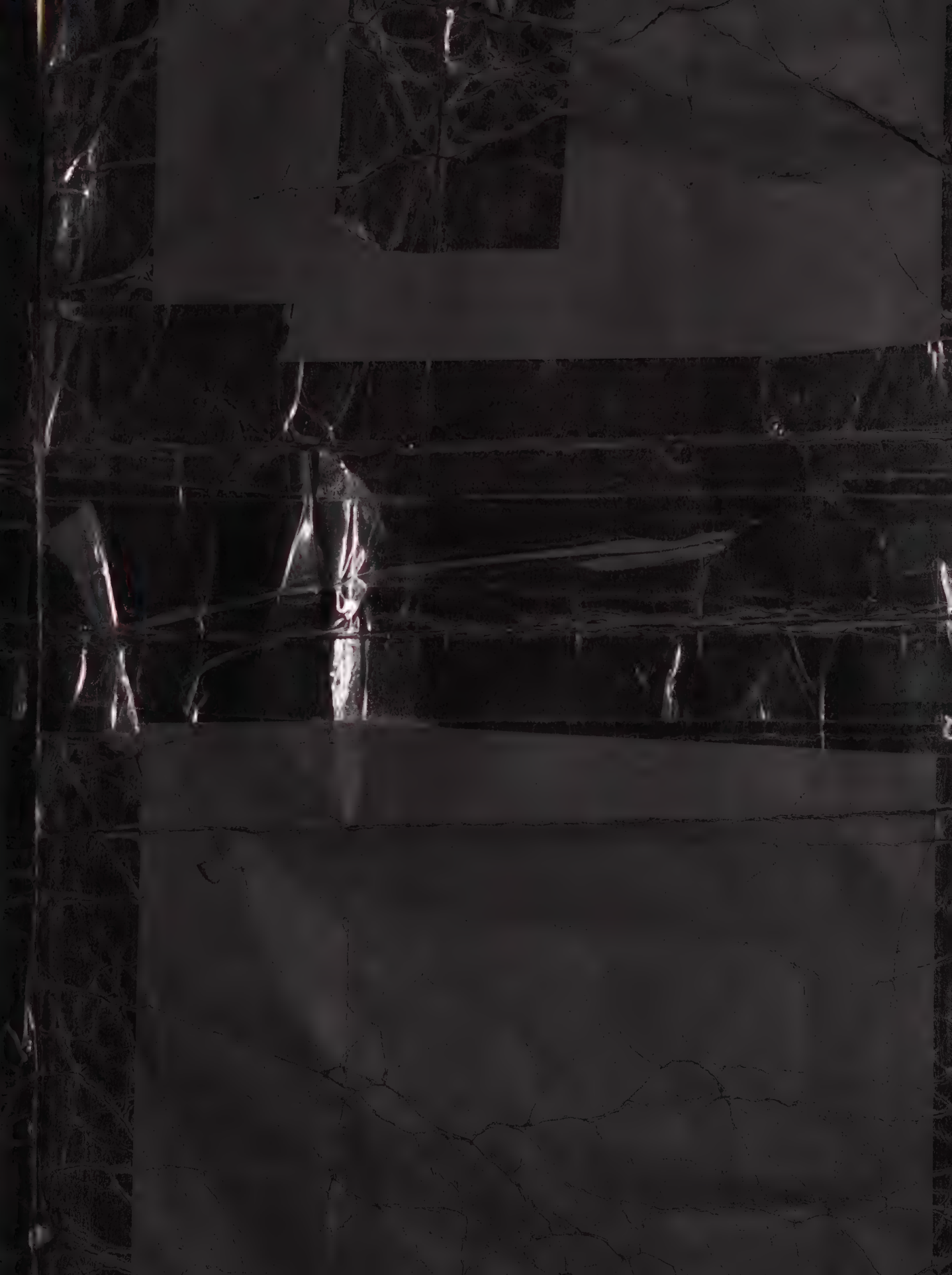

DATE
REV
CHANGE
APP'D
SWITCH
AUTO-MAN
SWITCH
PC-6
REMOTE
CHANNELING
BOARD
10.0065 MHz
Δf ASS'Y
BCD
REAR
PANEL
OUTPUT
FREQUENCY
COUNTER
ARINC
RD, PC-1
J23
DEMOD
(REAR PANEL)
OARD, PC-3
J3
RF OUT
(FRONT PANEL)
NAV-750
NEXT ASS'Y
QT'Y
MODEL
ITEM
REQ'D
PART NO.
DESCRIPTION
APPLICATION
LIST OF MATERIALS
TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS .xx = ± .010 .xxx = ± .005
ANGLES ± 1/2°
FRACTIONS ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS
DRAWN
DATE
CHECKED
DATE
APPROVED
DATE
1-28-77
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.
TITLE
RF & FREQUENCY
SELECT DIAGRAM
NAV-750
MATERIAL
TREATMENT
FINISH
SIZE
PART NUMBER
3 16-0227
REV
SCALE
WEIGHT
SHEET 1 OF 1

FIG. 4-7


.01°–.05°
SELECT
COUNTER
IN BRG.
MODE
TO
FROM
LOC
G/S
FRONT PANE
FREQUENCY SELECT
B.C.D.
FREQUENCY CONTR
B.C.D.
REMOTE CHANNELING
1-8
B.C.D.
REAR
PANEL
OUTPUT
+11 v
-11 v
BRG. INFO
SYNTHESIZER
9960 Hz W/FM DEVIATION
30 Hz REF.
30 Hz VAR.
1020 Hz
BEARING LOGIC BOARD
PC-4
G/S
DDM SELECT SWITCH
LOC
DDM
SWITCH
-11v
+11v
LOCALIZER/
BRG. CONTROL BOARD
PC-5
SYNTHESIZER
90 Hz
150 Hz
BRG
WHEEL
G/S
LOC
DDM CTR. ADJ.



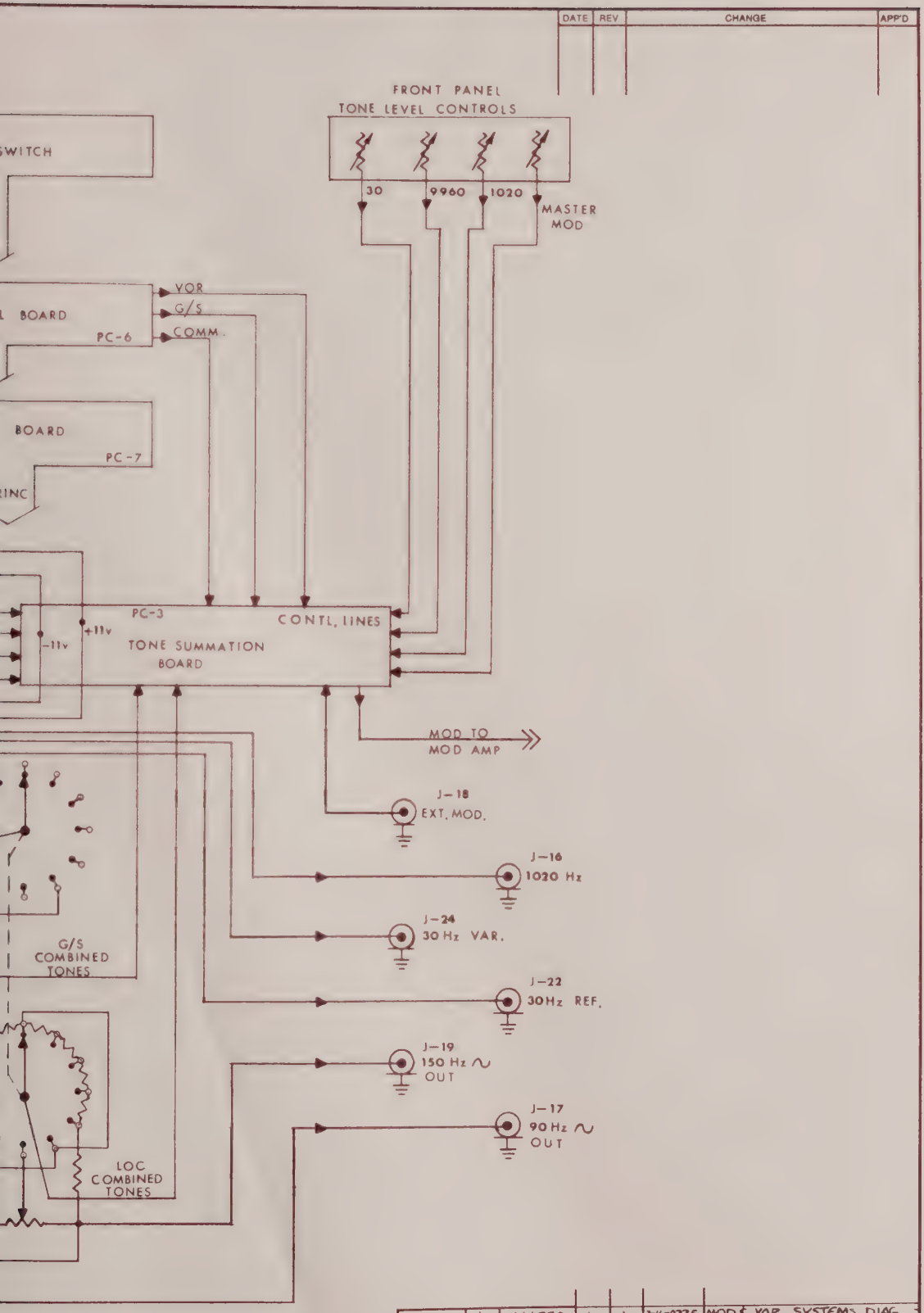


FIG. 4-8

	1	NAV-150	1	1	3-16-0235	MOD & VOR SYSTEMS DIAG.
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION

APPLICATION — LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN DATE LD 1/27/75
CHECKED DATE CF 1/27/75
APPROVED DATE 1-29-75

MATERIAL
TREATMENT
FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE: MODULATION & VOR SYSTEMS DIAGRAM.

SIZE — PART NUMBER 3-16-0235 — REV

SCALE NONE. — WEIGHT — SHEET 1 OF 1

NAV-750

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SECTION V

Performance Evaluation

5-1. Introduction.

5-2. This section contains information concerning the procedures necessary in an initial performance check of the NAV-750, and in any calibration procedure. These checks should not be performed without a thorough knowledge of the operating procedures as explained in Section III, and the theory of operation as shown by the block diagrams and explained in Section IV.

5-3. This instrument has been calibrated at the factory and should require only a periodic inspection and calibration Please do not attempt any adjustment except as specified within.

Performance Evaluation

And Reference of Adjustment Procedures

5-4. Purpose.

The purpose of this procedure is to verify the proper performance of the NAV-750 or NAV-750A unit in question and to reference alignment corrections.

5-5. Test Procedures.

5-6. General: The following tests should be done in the sequence given. Before attempting any of these procedures, one should be thoroughly familiar with the operation of the Front Panel controls as outlined in Section III.

5-7 References are made in this section to adjustments which are detailed in the Calibration Section. These references are included for convenience only, and should not be attempted by anyone performing an Initial Check or Performance Evaluation without first consulting the Calibration Section.

5-8. The referenced adjustments are not to be made unless an actual malfunction or maladjustment exists.

5-9. If improper operation is noted, and the circuit cannot be adjusted to operation within specifications, consult the troubleshooting portion of the manual.

TABLE (5-1)

Required Test Equipment and Fixtures.

Digital Voltmeter. . .	Fluke 8000A or equivalent
VOM.	20,000 ohms/volt minimum impedance
Oscilloscope	Dual-Trace, minimum 40 MHz frequency response (Typically DUMONT 1052) with delayed sweep capability
RF Frequency Counter.	120 MHz minimum frequency response, minimum sensitivity of -10 dBm, time base accuracy .00005%
Audio Frequency Counter. . . .	resolution ±0.1Hz
RF Power Meter. . . .	General Microwave 460B with 1mW power head or equivalent
Audio Distortion Analyzer. . .	HP 334A Distortion Analyzer or equivalent
RF Signal Generator.	Wavetek Model 2000 or similar
Course or Bearing Standard	IFR CS-360 or similar
AC/DC Differential Voltmeter .	Fluke model 883AB or equivalent
Receiver. . .	Minimum sensitivity 1.0uV (Tunable to a frequency between 108.00-157.95 MHz)

Optional Test Equipment.

Required for Spectrum Analyzis, Modulation Percentage measurements, and other procedures outlined in the Alignment and Troubleshooting Sections.

Spectrum Analyzer.	HP 8554L RF Section, 8552 IF Section, 140T or 141T Display Section
Wave Analyzer.	HP 3590 w/3593 plug-in or equivalent
Attenuator.	HP 355D w/option H83

NOTE

Refer to IFR Procedure (P/N 1-00-0137) for Percentage of Modulation verification.

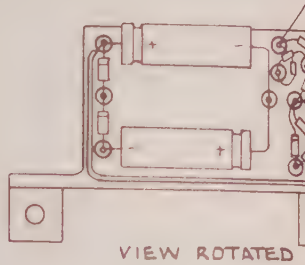
Crystal-controlled or other type oscillator capable of operation 50 kHz away from the carrier frequency of the NAV-750. Must have residual FM of 50Hz P-P or less.

0-500 MHz Mixer/Filter. . . . IFR P/N 2-00-0136 or equivalent

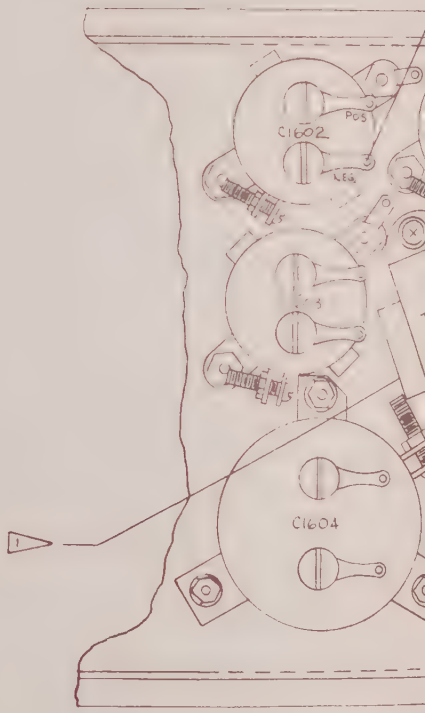
Circuit Board Extender Ass'y . IFR P/N 2-16-0211

Circuit Board Extender Ass'y . IFR P/N 2-16-0212

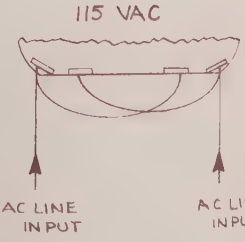
Flexible Test Cable. . . . . .IFR P/N 1-16-0214 (Up to five required)



VIEW ROTATED



1 BEGINNING WITH S/N 270, TRANSFORMER T-2 HAS BEEN REMOVED AND REPLACED BY TRANSFORMER T-1, TERMINALS 12 & 13.



DATE	REV	CHANGE	APP'D

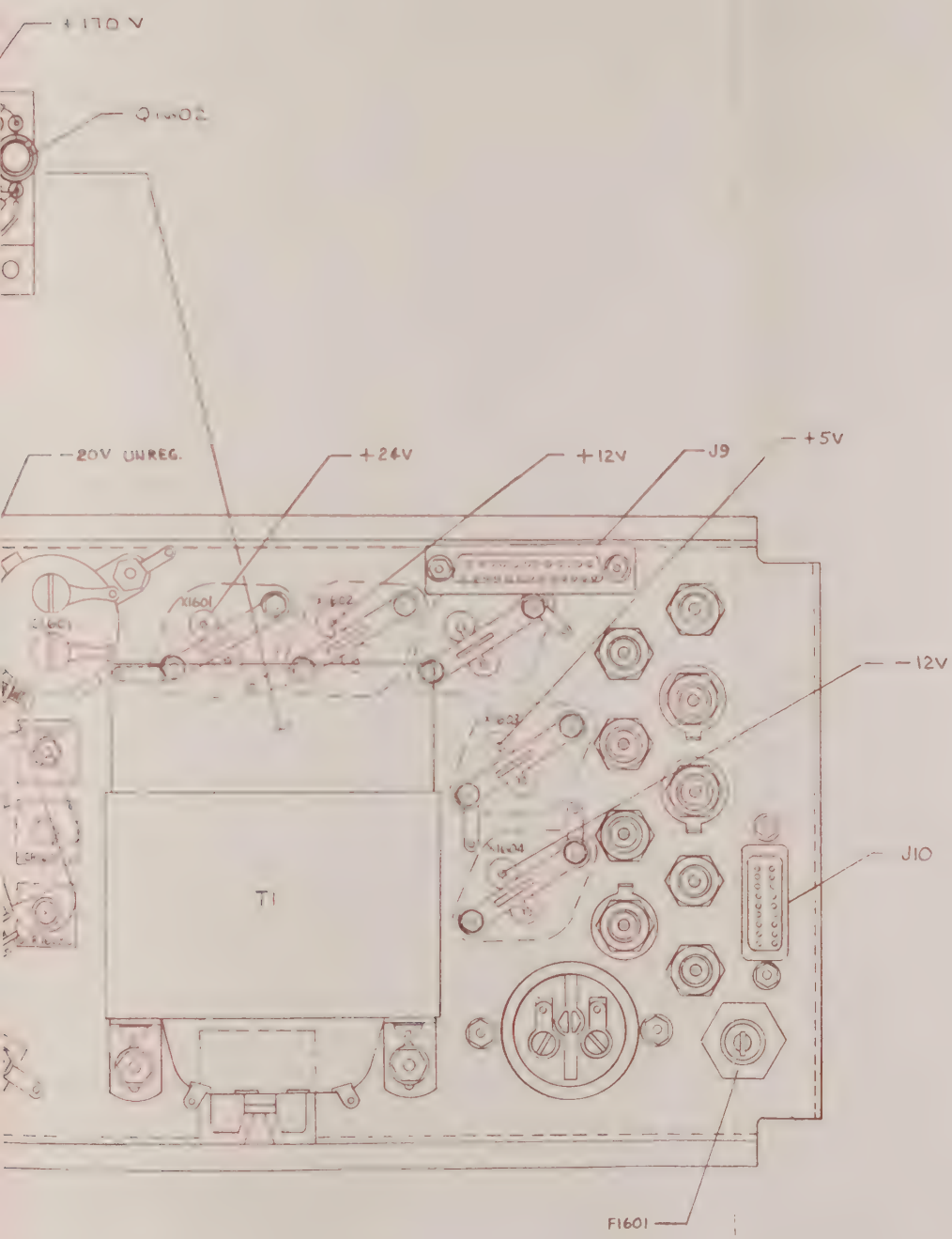
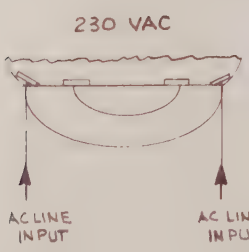


Fig 5-1



NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
		NAV-750				
APPLICATION						LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .006
ANGLES ± 1/2°
FRACTIONS ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

DRAWN G.L.D. DATE 12/4/74
CHECKED DATE 12/17/74
APPROVED DATE 12-31-74

MATERIAL
TREATMENT
FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE
REAR PANEL POWER SUPPLY VOLTAGE TEST POINTS AND COMPONENT DESIGNATIONS

SIZE C | PART NUMBER 3-16-0238 | REV
SCALE 1:1 | WEIGHT | SHEET 1 OF 1

5-10. Initial Procedures.

1. Remove top and side covers.
2. Apply AC power as per normal operation.
3. Verify the AC input voltage to be between 105 and 120 VAC rms (or 220 to 250 VAC rms), 50 to 400Hz.

5-11. ——— NOTE ———

Allow at least 15 minutes of equipment warm-up time before proceeding.

5-12. A. Power Supply Voltages.

1. Measure the power supply voltages at the points indicated with the Digital Voltmeter.

TABLE (5-2)
(Refer to Fig 5-1)

Test Point	Voltage	
Reg X1601	+24 VDC (23-25V)	No Adjustment
Reg X1602	+12 VDC (11.6-12.4V)	No Adjustment
Reg X1603	+5 VDC (4.7-5.3V)	No Adjustment
Reg X1604	-12 VDC (11.6-12.4V)	No Adjustment
Neg (-) Lead C1602 See Fig 5-1	-20 VDC (-17-22V) Unreg	No Adjustment
High Voltage TP	+170 VDC (~~160-180V~~ 155-180V @ Line voltage of 115 VAC)	No Adjustment
Collector Q314	+11 VDC (10.9-11.1V)	No Adjustment
Collector Q313	-11 VDC (10.9-11.1V)	No Adjustment

5-13. ——— NOTE ———

The adjustments of the positive and negative 11V power supplies will differ according to unit serial number and incorporation of the 11V tracking Regulator Modification on PC-3.

5-14. In those units with serial numbers below 178, the +11V supply is adjusted by R362, and the -11V supply is adjusted by R355. (Both adjustments on PC-3) On later models (or those in which the PC-3 modification has been made) R362 serves as the only adjustment for both the positive and negative 11V supplies.

5-10. Initial Procedures.

1. Remove top and side covers.
2. Apply AC power as per normal operation.
3. Verify the AC input voltage to be between 105 and 120 VAC rms (or 220 to 250 VAC rms), 50 to 400Hz.

5-11. ———— NOTE ————

Allow at least 15 minutes of equipment warm-up time before proceeding.

5-12. A. Power Supply Voltages.

1. Measure the power supply voltages at the points indicated with the Digital Voltmeter.

TABLE (5-2)
(Refer to Fig 5-1)

Test Point	Voltage	
Reg X1601	+24 VDC (23-25V)	No Adjustment
Reg X1602	+12 VDC (11.6-12.4V)	No Adjustment
Reg X1603	+5 VDC (4.7-5.3V)	No Adjustment
Reg X1604	-12 VDC (11.6-12.4V)	No Adjustment
Neg (-) Lead C1602 See Fig 5-1	-20 VDC (-17-22V) Unreg	No Adjustment
High Voltage TP	+170 VDC (~~160-180V~~ 155-180V + Line Voltage of 115 VAC)	No Adjustment
Collector Q314	+11 VDC (10.9-11.1V)	No Adjustment
Collector Q313	-11 VDC (10.9-11.1V)	No Adjustment

5-13. ———— NOTE ————

The adjustments of the positive and negative 11V power supplies will differ according to unit serial number and incorporation of the 11V tracking Regulator Modification on PC-3.

5-14. In those units with serial numbers below 178, the +11V supply is adjusted by R362, and the -11V supply is adjusted by R355. (Both adjustments on PC-3) On later models (or those in which the PC-3 modification has been made) R362 serves as the only adjustment for both the positive and negative 11V supplies.

5-15. Most important in both cases is the balance of the absolute values of both supplies. They must be balanced to within .150V. Refer to page 6-19 paragraph 6-35

5-16. RF and Frequency Select System.

5-17. Manual Advance: Control settings:

Counter Mode Switch. . . . . FREQ

AUTO-MANUAL Switch . . . . . MANUAL

Channeling Rate Control. . . . . .Max CCW

1. Select generator frequencies from 108.0 MHz to 157.95 MHz, in 1 MHz steps, using the thumbwheel Frequency Select Switch.

2. The NAV-750 counter should indicate the frequency selected, and the Ø LOCK lamp should remain ON throughout the entire specified frequency range.

5-18. Step Advance: Control settings:

Counter Mode Switch. . . . . FREQ

Frequency Select Switch. . . . . .108.0 MHz

Channeling Rate Control. . . . . .Max CCW

AUTO-MANUAL Switch. . . . . .AUTO

1. Verify the NAV-750 counter reading to be 108.0 MHz and stable (± 1 digit).

2. Rotate the Channeling Rate control CW until a "beep" sounds from the unit's speaker. As the Channeling Rate control is rotated CW, the counter should indicate frequencies increasing in increments chosen by the kHz switch and increasing in speed according to the degree of rotation (CW) of the Channeling Rate control. Verify the CHANNELING lamp to be ON.

5-19. Automatic Channeling "Stop" Points:

1. Verify the automatic channeling to stop at 117.95 and 135.975 MHz.

2. When the channeling stops, reset the Frequency Select switch to the next higher frequency, set the AUTO-MANUAL switch to MANUAL and then back to AUTO. Channeling will continue to the next "stop" point.

3. Verify the END lamp to be ON at each "stop" point.

5-20. G/S Paired Frequency Output: Control settings:

LOC/GS Switch . . . . . .GS
AUTO-MANUAL Switch. . . . . .MANUAL
Counter Mode Switch . . . . . .FREQ
Frequency Select Switch . . . . . 108.1 MHz

LOC - GS Freq Pairing Chart

LOC	GS	LOC	GS
108.10	334.70	110.10	334.40
108.15	334.55	110.15	334.25
108.30	334.10	110.30	335.00
108.35	333.95	110.35	334.85
108.50	329.90	110.50	329.60
108.55	329.75	110.55	329.45
108.70	330.50	110.70	330.20
108.75	330.35	110.75	330.05
108.90	329.30	110.90	330.80
108.95	329.15	110.95	330.65
109.10	331.40	111.10	331.70
109.15	331.25	111.15	331.55
109.30	332.00	111.30	332.30
109.35	331.85	111.35	332.15
109.50	332.60	111.50	332.90
109.55	332.45	111.55	332.75
109.70	333.20	111.70	333.50
109.75	333.05	111.75	333.35
109.90	333.80	111.90	331.10
109.95	333.65	111.95	330.95

TABLE (5-3)

1. Verify the NAV-750 counter reading to be 334.7 MHz.

2. Select LOC frequencies per Table 5-3 and verify correct automatic pairing of Localizer and Glide-Slope frequencies.

5-21. RF Frequency Check: Control settings:

MASTER MOD Control. . . . . UNCAL Max CCW (0)
Frequency Select Switch . . . . . 110.0 MHz
Output Attenuator . . . . . -30 dBm
AUTO-MANUAL Switch. . . . . MANUAL

1. Verify the Ø LOCK lamp to be ON and the NAV-750 counter to display the chosen front panel frequency.

2. Connect the RF frequency counter to the front panel RF output jack (J3). Rotate the NAV-750 attenuator CW until the NAV-750 RF signal level is great enough to cause the RF Frequency Counter to read accurately.

3. Verify the RF frequency counter reading to be that of the frequency selected. (± 100Hz)

5-22. ——— NOTE ———

Adjustment of this frequency is located on the Phase Lock Board, and is detailed in the alignment procedure for that circuit. Refer to Figure (5-2)

5-23. △F Operation: Control settings:

Frequency Select Switch. . . . . .108.1 MHz
BEARING-FREQ Select Switch . . . . . FREQ
AUTO-MANUAL Switch. . . . . .MANUAL
△F Switch . . . . . .Uncal
LOC/GS Switch. . . . . .LOC

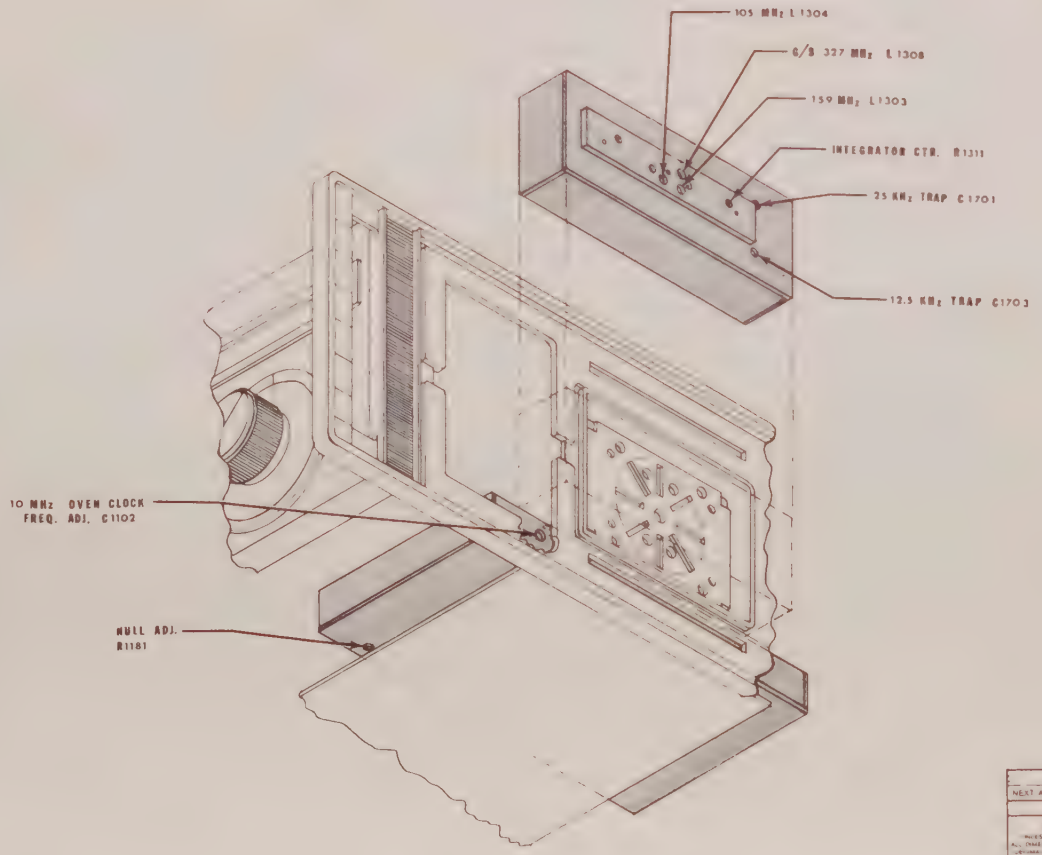
1. Verify the Ø LOCK lamp to be ON, and remain ON throughout the following operations.

2. Verify the △F UNCAL lamp to be ON.

3. Verify rotation of the △F control to vary the displayed frequency a minimum of ± 50 kHz from the selected carrier frequency.

4. Change the position of the LOC/GS switch to GS.

5. Verify the rotation of the △F control to vary the displayed frequency a minimum of ± 150 kHz from 334.7 MHz.



CALIBRATION ACCESS LOCATIONS –
OSCILLATOR & Ø LOCK ASSEMBLIES

FIG. 5-2

DATE	REV	CHANGE	APP'D

NEXT ASS'Y	QTY	MODEL	ITEM	REQ'D	PART NO	DESCRIPTION
		NAV-750				CAL ACCESS DWG.

APPLICATION — LIST OF MATERIALS

TOLERANCES: UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS APPLY AFTER FINISH. DECIMALS ±.005 ANGLES ± 1/2° FRACTIONS ± 1/64 SURFACE ROUGHNESS 125 REMOVE ALL BURRS

DRAWN — DATE
CHECKED — DATE
APPROVED — DATE

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA KANSAS

TITLE: CALIBRATION ACCESS DRAWING.

SIZE — PART NUMBER — REV
5 - 0237

MATERIAL
TREATMENT
FINISH

SCALE: NONE — WEIGHT — SHEET 1 OF 1

5-24. RF Spectrum.

5-25. RF Spectrum for standard LO/HI Band Oscillators.

Control settings:

Output Attenuator. . . . . .-20 dBm
MASTER MOD Control . . . . . .UNCAL Max CCW (0)
Frequency Select Switch. . . . . .108.0 MHz

Refer to Figure ~~(5-3)~~ (1-1 & 6-31) Select Spectrum Analyzer bandwidth of 300Hz.

1. Connect Spectrum analyzer to the front panel RF output jack (J3).

2. Verify the following specifications:

NAV-750

5-26. Harmonics (With -20 dBm RF output attenuator setting)

5-27. Greater than 30dB below carrier level at any selected frequency.

5-28. Close-In Noise

5-29. 108.0 MHz-greater than 78dB below carrier level at ±15 kHz.

5-30. 334.7 MHz-greater than 74dB below carrier level at ±20 kHz.

5-31. Non-Harmonic Spurious Noise (The phase-lock control frequency in the NAV-750 is 12.5 kHz)

5-32. ±12.5 kHz-68dB below carrier level
5-33. ±15.0 kHz-74dB below carrier level
5-34. ±25.0 kHz-71dB below carrier level

Level below carrier stated in a 300Hz bandwidth

5-35. (Above levels observe with a carrier frequency of 108.0 MHz and a carrier level of -20 dBm)

5-36. Broadband Noise

5-37. Greater than 80dB below carrier level at selected frequencies ±50 kHz or greater away from the carrier frequency.

5-38. Harmonics (With -20 dBm RF output attenuator setting)

5-39. Greater than 30dB below carrier level at any selected frequency.

5-40. Close-In Noise

5-41. 108.0 MHz-greater than 78dB below carrier level at ±15 kHz.

5-42. 334.7 MHz-greater than 74dB below carrier level at ±20 kHz.

5-43. Non-Harmonic Spurious Noise (The phase-lock control frequency in the NAV-750A is 12.5 kHz)

5-44. ±12.5 kHz-75dB below carrier level

5-45. ±15.0 kHz-78dB below carrier level

5-46. ±25.0 kHz-83dB below carrier level

Level below carrier stated in a 300Hz bandwidth

5-47. (Above levels observed with a carrier frequency of 108.0 MHz and a carrier level of -20 dBm)

5-48. Broadband Noise

5-49. Greater than 80dB below carrier level at selected frequencies ±50 kHz or greater away from the carrier frequency.

5-50. Residual FM

5-51. (Post-detection noise bandwidth - 20Hz to 15 kHz)

5-52. 108.0 MHz-±200Hz P-P or less

5-53. 334.7 MHz-±400Hz P-P or less

TYP. R.F. SPECTRUM
NAV-750
STANDARD OSCILLATOR

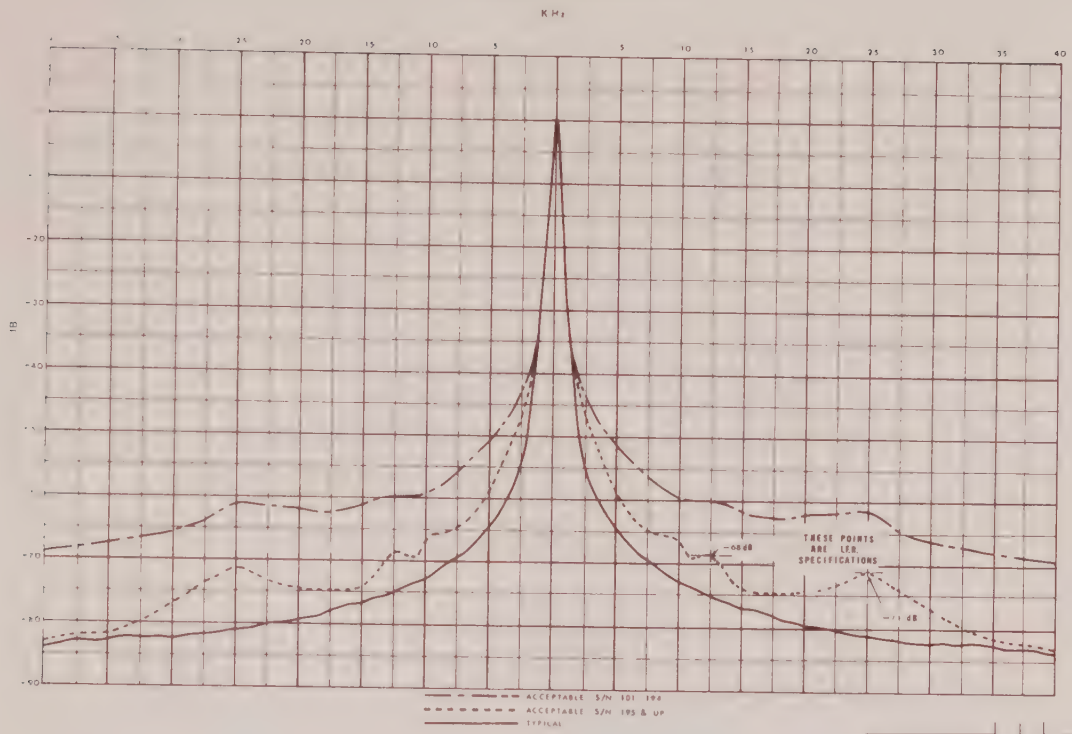


FIG. 5-4

TYP. R.F. SPECTRUM
NAV-750 (OPTION A)
8 STEP OSCILLATOR

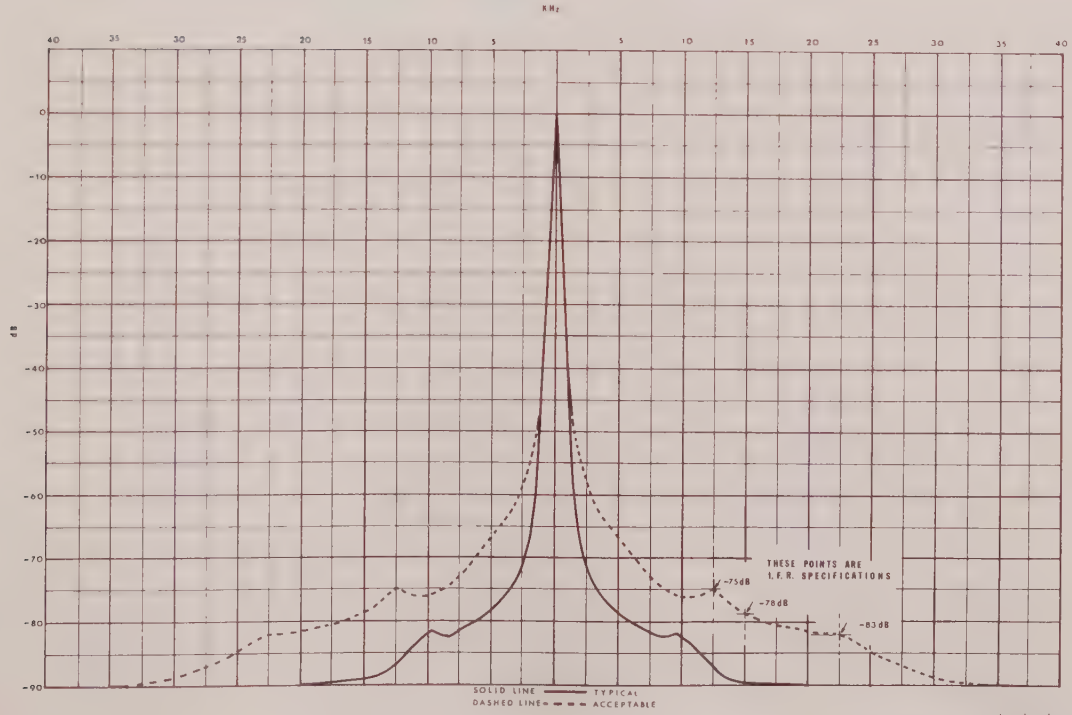


FIG. 5-4.1

5-54. RF Output Attenuator Calibration and Frequency Response.

Control settings:

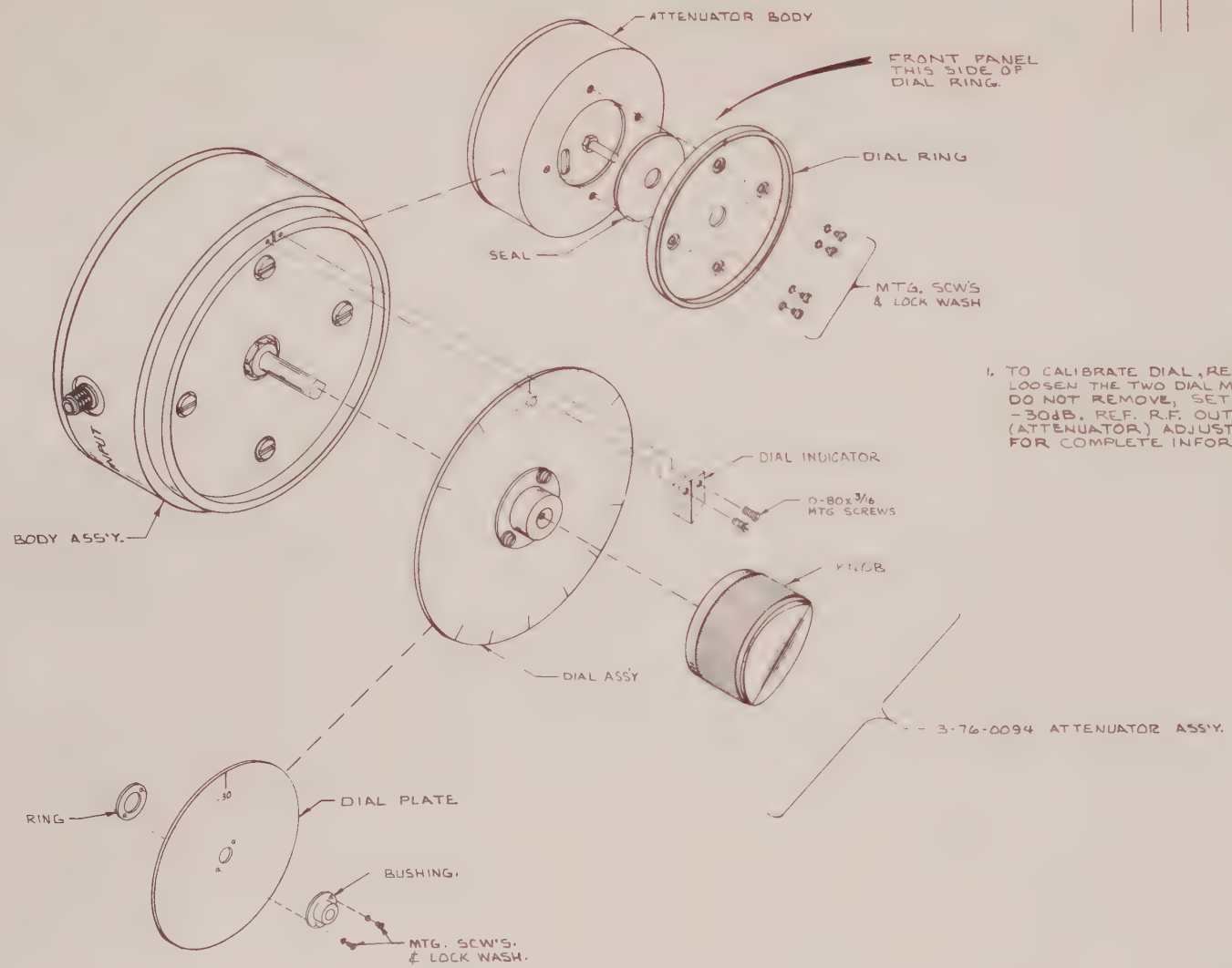
Output Attenuator. . . . . .-30 dBm
MASTER MOD Control . . . . . .UNCAL Max CCW (0)
Frequency Select Switch. . . . . .108.0 MHz

1. Connect the power meter to the RF Power Output jack (J3) on the front panel.

2. Verify the power meter reading to be -30 dBm (± 1.5 dBm).

3. Advance the Frequency Select switch across the frequency range of the generator, and verify the power level to remain at -30 dBm (± 1.5 dBm).

DATE	REV	CHANGE	APP'D



1. TO CALIBRATE DIAL, REMOVE KNOB & LOOSEN THE TWO DIAL MTG SCREWS BUT DO NOT REMOVE, SET DIAL TO -30dB. REF. R.F. OUTPUT LEVEL (ATTENUATOR) ADJUST PROCEDURE FOR COMPLETE INFORMATION

NEXT ASS'Y	QTY	MODEL	ITEM	REQ'D	PART NO	DESCRIPTION
3-76-0094	1	NAV 750			3-16-0225	ATTENUATOR

APPLICATION — LIST OF MATERIALS

TOLERANCES: UNLESS OTHERWISE SPECIFIED ... SURFACE ROUGHNESS ... REMOVE ALL BURRS

DRAWN — CHECKED — DATE — APPROVED — DATE

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: ATTENUATOR ASS'Y.

MATERIAL: NOTED
TREATMENT:
FINISH:

SIZE: — PART NUMBER: 3-16-0225 — REV:
SCALE: NONE — WEIGHT: — SHEET 1 OF 1

5-55. Modulation System.

Control settings:

30Hz. . . . . CAL
9960Hz. . . . . CAL
1020Hz. . . . . CAL
MASTER MOD. . . CAL
LOC DDM 0
G/S DDM 0

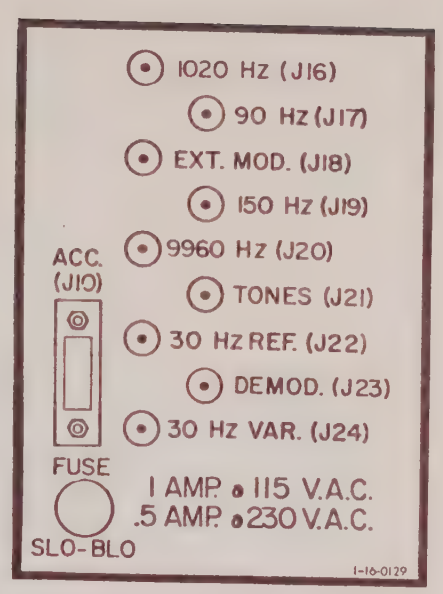


Fig 5-6

1. Using the frequency counter and the distortion analyzer, verify the frequency and distortion figures specified below. Each tone is available at a back panel jack (Refer to figure 5-6).

TONE	DISTORTION
30Hz Ref	0.5% Max

Adjustments R2039 (30Hz Ref Amp) and R2043 (30Hz Ref Cent) on PC-2 should be adjusted for minimum distortion.

30Hz Var	0.5% Max

Adjustments R2005 (30Hz VAR Cent) and R2001 (30Hz Var Amp) on PC-2 should be adjusted for minimum distortion.

1020Hz (±5Hz)	0.5% Max

The adjustments for this tone are located on PC-2 and are highly interactive. Refer to the Calibration Procedure for PC-2 if readings are outside the specifications.

9960Hz	1.3% Max

5-56. ——— NOTE ———

In order to check or adjust the 9960Hz tone for minimum distortion, it is first necessary to remove the 30Hz FM portion of the signal present at J20 (9960Hz). This is done by adjusting R2049 on PC-2 (9960Hz Dev) max CCW.

5-57. If the 9960Hz tone is not stable in frequency, or if the distortion exceeds the above specified limits, refer to the Calibration Section for detailed information concerning the adjustment of the 9960Hz phase-locked loop.

2. Reset the 9960 FM Deviation by adjusting R2049 on PC-2 as outlined in the procedure on the following page.

Set the oscilloscope controls as shown in Figure 5-7. Connect J20 (9960) of the NAV-750(A) to the scope vertical input and adjust scope positioning and triggering controls to vertically center the display and position the sweep trigger point at the left edge of the horizontal center line as shown in Figure 5-7. Adjust the FM DEV control (R2049) for a Δt of 48.5us (±2.4us) using the delayed sweep function to expand the display as in Figure 5-8.

NOTE

Accuracy of calibration is dependent on oscilloscope sweep timing accuracy.

Oscilloscope Settings:

Vertical:
.5V/DIV - Uncal

Horizontal:
Main Time Base-
100us/DIV

Triggering-
Positive Slope

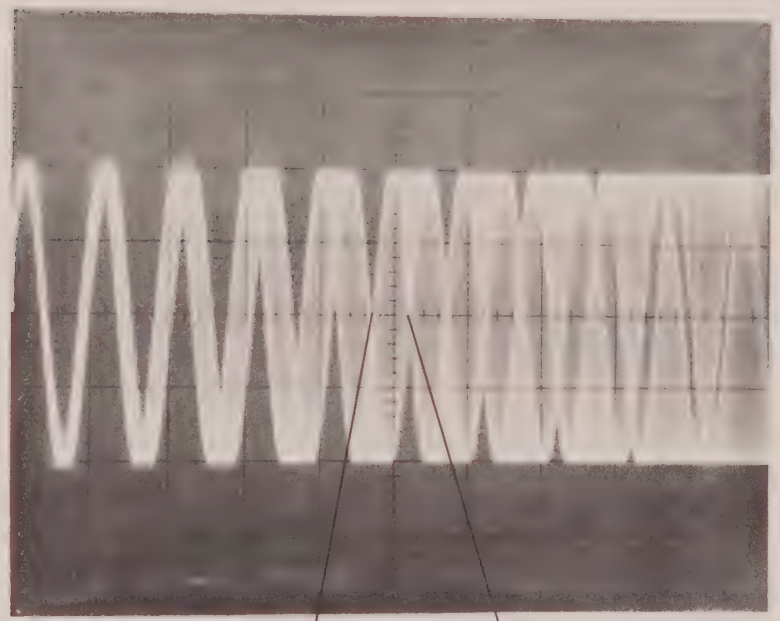
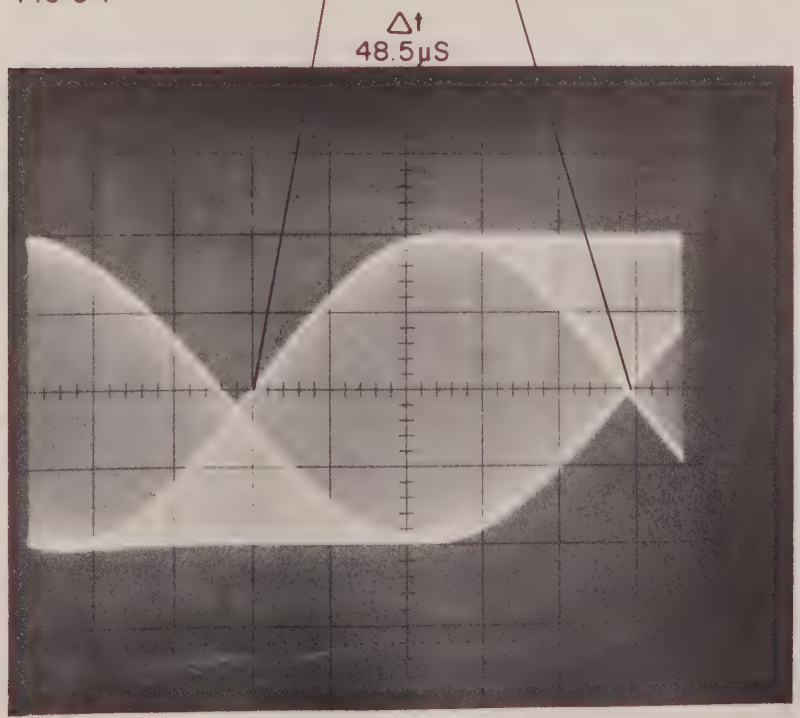


FIG 5-7



Oscilloscope Settings:

Vertical:
.5V/DIV - Uncal

Horizontal:
Delay Time Base-
10us/DIV

Triggering-
Positive Slope

FIG 5-8

5-58. 3. As in the preceding steps, confirm the specifications for the 90 and 150Hz tones.

TONE	DISTORTION
90Hz	0.5% Max

Adjustments R5049 (90Hz Amp) and R5085 (90Hz Cent) are located on PC-5, and should be adjusted for minimum distortion.

150Hz	0.5% Max

Adjustments R5082 (150Hz Cent) and R5078 (150Hz Amp) are located on PC-5, and should be adjusted for minimum distortion.

5-59. External Modulation: Control settings:

Frequency Select Switch. . . . . .108.0 MHz
9960Hz. . . . . UNCAL Max CCW (0)
MASTER MOD Control. . . . . Cal
Meter Function Switch 0-100

1. Connect the 30Hz REF output (J22) to the EXT MOD jack (J18).

2. Verify the front panel meter reading to be approximately 29.0% (28.5% - 31.5%).

5-60. Demodulation: Control settings:

5-61. ——— NOTE ———

The waveshapes present at the rear panel TONES jack (J21) should be the same as those at the DEMOD jack (J23) throughout the following steps.

All tone level controls . . . . . Cal

1. Connect an oscilloscope to the rear panel DEMOD jack (J23).

2. Select generator frequencies in the VOR/LOC/COMM and G/S ranges.

3. Verify the display on the oscilloscope indicates the proper type of modulation for each chosen frequency as the NAV-750 automatically selects the proper type modulation for the frequency range in use.

4. Verify the DC voltage at the TONE jack (J21) to be less than 60.0mV and to not vary more than ±60.0mV from 0.0V as the NAV-750 changes modulation with the different frequency ranges.

5-62. VOR System:

Control settings:

Frequency Select Switch. . . . . .108.0 MHz

All tone level controls. . . . . .Cal

Counter Mode Switch. . . . . .BEARING

5-63. Bearing Generator Operation.

1. Depress the 30° step select buttons and note the correct corresponding bearing indication on the NAV-750 counter.

2. Depress the +10° and -10° step buttons and verify the bearing indication to correctly increase or decrease in 10° increments.

3. Rotate the Bearing Wheel CW and verify an increase in the indicated bearing by the increment chosen with the .01° - .05° select switch.

5-64. ———— NOTE ————

If improper operation is noted in steps 3 or 4 refer to the adjustment procedure for PC-5.

5-65. Bearing Accuracy.

1. Verify proper VOR modulation at the DEMOD jack (J23).

2. Verify the VOR lamp to be ON.

3. Using the IFR CS-360 or similar bearing measurement device, check the bearing accuracy of the NAV-750 at the rear panel DEMOD jack (J23). ($\pm$0.05 degree at cardinal heading).

5-66. ———— NOTE ————

With the IFR CS-360, a check may be made at the front panel RF Output Jack (J3).

5-67. LOC System.

Control settings:

Frequency Select Switch. . . . . .108.1 MHz
1020Hz. . . . . CAL
MASTER MOD. . . . . CAL
LOC DDM 0
LOC-G/S Select Switch . . . . . LOC
G/S DDM 90Hz

1. Verify the LOC Lamp to be ON.

2. Verify the 150Hz lamp to be ON.

5-68.

———— NOTE ————

The lamp ON indicates the tone not present.

3. Select 150Hz on the G/S DDM switch and verify the 90Hz lamp to be ON.

4. Select the LOC DDM settings as shown in the table below, delete the tones with the G/S DDM switch as explained above, and measure the DEMOD VAC at J23 (DEMOD). Record the values, and calculate the ratios as shown in the table.

5. Select 0 DDM and measure:

TABLE (5-3)

(±2.75mV=± .001 DDM) 150Hz AC DEMOD _____
90Hz AC DEMOD _____ (Within ± 1mV of 150Hz AC DEMOD)

Select .155 DDM (right) and measure:

(±1.2% DDM) 90Hz AC DEMOD _____
150Hz AC DEMOD _____ ÷ _____ 2.265 (2.240-2.290)

Select .155 DDM (left) and measure:

(±1.2% DDM) 150Hz AC DEMOD _____
90Hz AC DEMOD _____ ÷ _____ 2.265 (2.240-1.290)

Select .093 DDM (right) and measure:

(±1.25% DDM) 90Hz AC DEMOD _____

150Hz AC DEMOD _____ ÷ _____ = 1.606 (1.596-1.616)

Select .093 DDM (left) and measure:

(±1.25% DDM) 150Hz AC DEMOD _____

90Hz AC DEMOD _____ ÷ _____ = 1.606 (1.596-1.616)

5-69. G/S System.

Control settings:

Frequency Select Switch . . . . . 108.1 MHz
1020Hz . . . . . .Cal
MASTER MOD . . . . . .Cal
G/S DDM. 0
LOC-G/S Select Switch. . . . . GS

1. Verify the G/S lamp to be ON.

2. Verify the 150Hz lamp to be ON.

5-70. ———— NOTE ————

The lamp ON indicates the tone not present.

3. Select 150Hz and the LOC DDM switch and verify the 90Hz lamp to be ON.

4. Select the G/S DDM settings as shown in the table below, delete the tones with the LOC DDM switch as explained above, and measure the DEMOD VAC at J23 (DEMOD). Record the values, and calculate the ratios as shown in the table.

5. Select 0 DDM and measure:

TABLE (5-4)

(±2.75mV=± .001 DDM) 150Hz AC DEMOD _____
90Hz AC DEMOD _____ (Within ± 1mV of 150Hz AC DEMOD)

Select .175 DDM (right) and measure:

(±1.4% DDM) 150Hz AC DEMOD _____
90Hz AC DEMOD _____ ÷ _____ (1.550-1.570) 1.560

Select .175 DDM (left) and measure:

(±1.4% DDM) 90Hz AC DEMOD _____
150Hz AC DEMOD _____ ÷ _____ (1.550-1.570) 1.560

Select .091 DDM (right) and measure:

(±1.2% DDM) 150Hz AC DEMOD _____

90Hz AC DEMOD _____ ÷ _____ $\frac{1.257}{(1.253\text{-}1.260)}$

Select .091 DDM (left) and measure:

(±1.2% DDM) 90Hz AC DEMOD _____

150Hz AC DEMOD _____ ÷ _____ $\frac{1.257}{(1.253\text{-}1.260)}$

6. Monitor the DEMOD jack (J23) with the oscilloscope.

7. Select a 12° bearing using the Bearing Wheel and depress the Ø button. Observe the phase shift.

8. Select a 24° bearing using the Bearing Wheel and again depress the Ø button. Observe the phase shift.

Metering Circuits.

Control settings:

LINE switch. . . . . .OFF

1. Verify the front panel meter to be mechanically zeroed at the left edge of the scale.

0-100% Modulation Scale: Control settings:

Meter Function Switch. 0-100
MASTER MOD Control. . . . . UNCAL
9960Hz . . . . . .UNCAL Max CCW (0)
1020Hz . . . . . .Cal
30Hz . . . . . .UNCAL
Frequency Select Switch. . . . . .108.0 MHz

1. Connect the oscilloscope to the rear panel DEMOD jack (J23).

2. Advance the 30Hz and MASTER MOD controls CW until the 30Hz sine wave displayed on the scope just begins to clip on the negative portion of the wave. There should be no evidence of clipping on the positive portion of the wave.

3. Verify the meter reading to be 100% (±1.5%). Adjustment for the 100% point of the modulation meter is R349 on PC-3.

4. Note the AC voltage at the DEMOD jack (J23) with the modulation set, as above, at 100% _____

5. Multiply the AC voltage reading taken in step 4 by 0.3, and note this calculation. _____

0-30% Modulation Scale: Control settings:

Meter Function Switch. 0-30
9960Hz. . . . . UNCAL Max CCW (0)
All other tone level controls . . . . . Cal

1. Verify the meter reading to be 30% (±1.5%) Adjustment for the 30% point of the modulation meter is R348 on PC-3.

Select .091 DDM (right) and measure:

(±1.2% DDM) 150Hz AC DEMOD _____

90Hz AC DEMOD _____ ÷ _____ $\frac{1.257}{(1.253\text{-}1.260)}$

Select .091 DDM (left) and measure:

(±1.2% DDM) 90Hz AC DEMOD _____

150Hz AC DEMOD _____ ÷ _____ $\frac{1.257}{(1.253\text{-}1.260)}$

6. Monitor the DEMOD jack (J23) with the oscilloscope.

7. Select a 12° bearing using the Bearing Wheel and depress the Ø button. Observe the phase shift.

8. Select a 24° bearing using the Bearing Wheel and again depress the Ø button. Observe the phase shift.

Before making the following measurements, verify the centering to be ± 0.27mV in order to minimize centering error contribution to tone ratio measurements.

The high and low limits of the tone ratios shown below indicate a variance of ± .00025 ddm from the desired value.

TABLE 5-3A

LOC ddm Settings and Tone Ratios

(± 0.27mV = ± .0001 ddm)

Centering Adjust: 150Hz AC DEMOD
90Hz AC DEMOD (within ± 0.27 mV)

Select .046 ddm (right) and measure:

$$\frac{\text{90Hz AC DEMOD } [\quad]}{\text{150Hz AC DEMOD } [\quad]} = [\quad] \quad 1.2599 \quad 1.2583 - 1.2615$$

Select .046 ddm (left) and measure:

$$\frac{\text{150Hz AC DEMOD } [\quad]}{\text{90Hz AC DEMOD } [\quad]} = [\quad] \quad 1.2599 \quad 1.2583 - 1.2615$$

Select .093 ddm (right) and measure:

$$\frac{\text{90Hz AC DEMOD } [\quad]}{\text{150Hz AC DEMOD } [\quad]} = [\quad] \quad 1.6059 \quad 1.6037 - 1.6080$$

Select .093 ddm (left) and measure:

$$\frac{\text{150Hz AC DEMOD } [\quad]}{\text{90Hz AC DEMOD } [\quad]} = [\quad] \quad 1.6059 \quad 1.6037 - 1.6080$$

Select .155 ddm (right) and measure:

$$\frac{\text{90Hz AC DEMOD } [\quad]}{\text{150Hz AC DEMOD } [\quad]} = [\quad] \quad 2.2653 \quad 2.2620 - 2.2686$$

Select .155 ddm (left) and measure:

$$\frac{\text{150Hz AC DEMOD } [\quad]}{\text{90Hz AC DEMOD } [\quad]} = [\quad] \quad 2.2653 \quad 2.2620 - 2.2685$$

Select .200 ddm (right) and measure:

$$\frac{\text{90Hz AC DEMOD } [\quad]}{\text{150Hz AC DEMOD } [\quad]} = [\quad] \quad 3.000 \quad 2.9950 - 3.0050$$

Select .200 ddm (left) and measure:

$$\frac{\text{150Hz AC DEMOD } [\quad]}{\text{90Hz AC DEMOD } [\quad]} = [\quad] \quad 3.000 \quad 2.9950 - 3.0050$$

Before making the following measurements, verify the centering to be ± 0.27mV in order to minimize centering error contribution to tone ratio measurements.

The high and low limits of the tone ratios shown below indicate a variance of ± .00025 ddm from the desired value.

TABLE 5-4A

G/S ddm Settings and Tone Ratios

(± 0.27mV = ± .0001 ddm)

Centering Adjust: 150Hz AC DEMOD / 90Hz AC DEMOD (within ± 0.27 mV)

Select .045 ddm (left) and measure:

$$\frac{\text{90Hz AC DEMOD } [\quad]}{\text{150Hz AC DEMOD } [\quad]} = [\quad] \quad 1.1185 - 1.1199$$

Select .045 ddm (right) and measure:

$$\frac{\text{150Hz AC DEMOD } [\quad]}{\text{90Hz AC DEMOD } [\quad]} = [\quad] \quad 1.1185 - 1.1199$$

Select .091 ddm (left) and measure:

$$\frac{\text{90Hz AC DEMOD } [\quad]}{\text{150Hz AC DEMOD } [\quad]} = [\quad] \quad 1.2559 - 1.2575$$

Select .091 ddm (right) and measure:

$$\frac{\text{150Hz AC DEMOD } [\quad]}{\text{90Hz AC DEMOD } [\quad]} = [\quad] \quad 1.2559 - 1.2575$$

Select .175 ddm (left) and measure:

$$\frac{\text{90Hz AC DEMOD } [\quad]}{\text{150Hz AC DEMOD } [\quad]} = [\quad] \quad 1.5590 - 1.5610$$

Select .175 ddm (right) and measure:

$$\frac{\text{150Hz AC DEMOD } [\quad]}{\text{90Hz AC DEMOD } [\quad]} = [\quad] \quad 1.5590 - 1.5610$$

Select .400 ddm (left) and measure:

$$\frac{\text{90Hz AC DEMOD } [\quad]}{\text{150Hz AC DEMOD } [\quad]} = [\quad] \quad 2.9975 - 3.0025$$

Select .400 ddm (right) and measure:

$$\frac{\text{150Hz AC DEMOD } [\quad]}{\text{90Hz AC DEMOD } [\quad]} = [\quad] \quad 2.9975 - 3.0025$$

Metering Circuits.

Control settings:

LINE switch. . . . . .OFF

1. Verify the front panel meter to be mechanically zeroed at the left edge of the scale.

0-100% Modulation Scale: Control settings:

Meter Function Switch. 0-100
Frequency Select Switch. . . . . .108.10 MHz
LOC/GS Switch. . . . . .GS
LOC DDM Switch 0
G/S DDM Switch 90Hz

1. Using the procedure on page 5-28, verify depth of modulation to be 40% (± 1.6%)

2. Verify the front panel meter reading to be 40% (±1.6%). Adjustment for this reading is R349 on PC-3.

0-30% Modulation Scale: Control settings:

Meter Function Switch. 0-30
LOC/GS Switch. . . . . LOC
LOC DDM Switch 90Hz
G/S DDM Switch 0

1. Using the procedure on page 5-28, verify depth of modulation to be 20% (± 0.8%).

2. Verify the front panel meter reading to be 20%. (± 0.8%). Adjustment is R348 on PC-3.

2. Verify the AC voltage reading at the rear panel DEMOD jack (J23) to be equal to the value calculated in step 5 of the 100% modulation procedure (±0.030V).

RF Level Scale: Control settings:

Meter Function Switch. . . . . RF

All ton level controls . . . . . .Cal

1. Select any frequency within the range of the generator.

2. Verify the Ø LOCK lamp to be ON.

3. Verify the meter reading to be on the center scale mark at all times.

———— NOTE ————

Adjustment for this meter position is R343 (RF Level) on PC-3. This adjustment does not affect the actual RF Leveling operation of the generator, but simply provides position calibration of the meter neele in the RF position. Refer to Calibration Section for PC-3.

Zero Scale (Bearing Check): Control Settings:

Frequency Select Switch. . . . Frequency in VOR range

Meter Function Switch. . . . . ZERO

Selected Bearing. . . . . 90°

1. Allow approximately one minute for circuit stabilization.

2. Adjust BEARING ZERO control in both CW and CCW directions and verify the meter needle swings both right and left of the BRG ZERO position.

3. Adjust the BEARING zero control for a BRG ZERO indication on the meter.

4. Verify no appreciable drift of the meter needle after the adjustment in step 3.

BRG (Bearing Error Scale): Control settings:

Frequency Select Switch . . . .Frequency in VOR

TO-FROM Select Switch. . . . . .TO position

Selected Bearing. . . . . 90°

1. Momentarily return the Meter Function Switch to ZERO position and "zero" the meter as in the previous procedure.

2. Place the Meter Function Switch in the BRG position.

3. Verify a center scale (0°) indication (±0.05°) on the meter.

4. Select the FROM position of the TO-FROM Select Switch.

5. Observe the meter needle to move to an off-center indication and returns to center scale (0° ±0.05°).

6. Depress the 270° Bearing Select Button.

7. Verify the meter reading to be 0° ±0.05° (center scale)

NOTE

If improper operation in the ZERO or BRG positions is observed, refer to the calibration procedure for PC-1.

MEASUREMENT PROCEDURE FOR AM MODULATION DEPTH

General:

This procedure is used to accurately determine the depth of AM modulation (internal) of the NAV-750(A)'s generated signal in the VOR, LOC, COMM, and G/S frequency ranges. Measurements are made of both the ac and the dc components of the signal at the output of a Spectrum Analyzer linear peak detector with the Analyzer set to a zero frequency span. The dc offset (V_{off}) at the output of the detector is measured, and a correction is made in the calculations for this offset voltage.

Possibilities for error in this measurement exist in the uncertainty of attenuator accuracy and the measurement of the ac and dc voltages. Use of the HP 355D OPT H83 is specified here because of the Calibration Charts provided for 110 MHz and 330 MHz; and the opportunity, therefore, to correct calculations involving α (attenuation) accordingly. The voltmeter used should have a known accuracy of better than $\pm$ 0.1%. Using test equipment specified within (or equivalent), accuracies of the measurement using this procedure are better than $\pm$ 1.0% of the resultant calculated value.

i.e., A resultant calculated value of 30.0%, measured using this procedure, has an absolute value between 29.7% and 30.3%.

Required Test Equipment:

Spectrum Analyzer (with linear detector). . . . . HP8554L, 85552B, 140T or 141T

Stepped Attenuator. . . . . .HP355D OPT H83*

AC/DC Differential Voltmeter/OR . . . . . .Fluke 883AB or equivalent

Digital Voltmeter . . . . . .HP3480B/3484A or equivalent

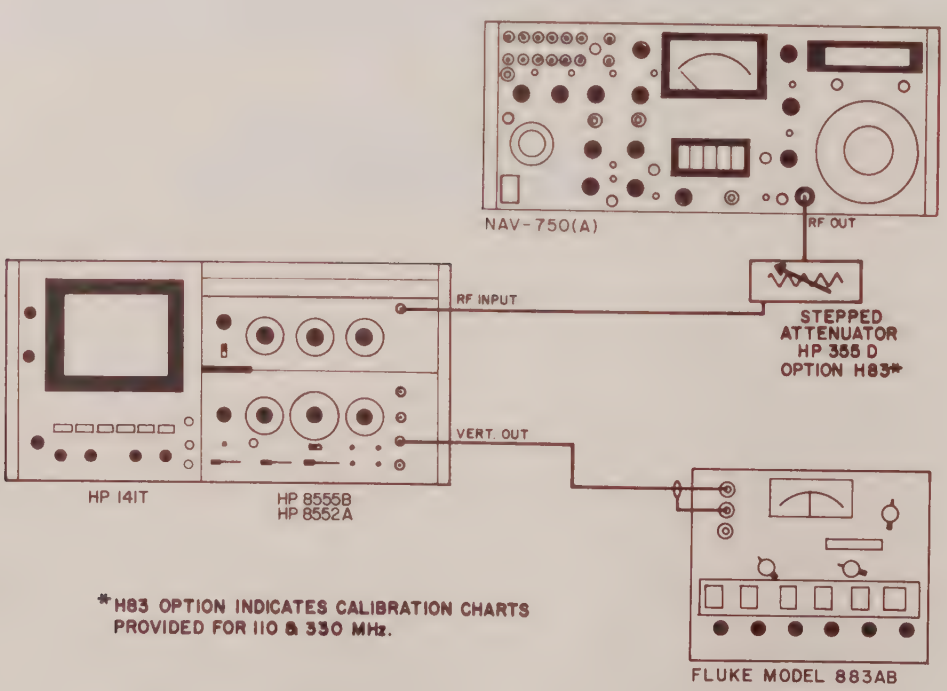
*H83 option indicates calibration at 110.0 and 330 MHz with Attenuator Calibration Chart provided.

A. Procedure:

1. Connect the test equipment and the NAV-750(A) as shown in Fig (5-9).

NOTE

A two hour equipment warm-up time should be allowed to minimize drift of the Spectrum Analyzer detector output.



Control settings: (NAV-750,A)

Meter Function Switch. 0-30
Frequency Select Switch. . . . . .108.0 MHz
MASTER MOD Control . . . . . .Cal
9960Hz . . . . . .UNCAL Max ccw
1020Hz . . . . . .Cal
30Hz . . . . . .Cal
Output Attenuator. . . . . .-30 dBm

Control settings: (Spectrum Analyzer)

BANDWIDTH. . . . . .300 kHz
SCAN WIDTH . . . . . .2 MHz/DIV
TUNING STABILIZER. . . . . ON
INPUT ATTENUATOR 10dB
FREQUENCY. . . . . .As required to center 108.0 MHz signal trace on display
SCALE. . . . . LINEAR
LINEAR SENSITIVITY 10mV/DIV

2. Peak the trace on the display with the center frequency controls. Reset Analyzer controls:

Frequency Span (SCAN WIDTH). . . . . ZERO
VIDEO FILTER . . . . . .OFF

3. Perform the V_{off} Measurement as described in the following procedure.

NOTE

If V_{off} for the Analyzer being used has been recently measured and noted, skip the following step and eliminate the calibrated attenuator from the test setup.

B. V_{off} Measurement.

NOTE

A correction factor equal to the Spectrum Analyzer's dc offset (V_{off}) is used in this procedure to compensate for the dc offset at the output of the detector. Measurement of this offset voltage is accomplished in the following step, and MUST be performed to insure the accuracy of this test.

1. All Controls as in step A.1 except:

   NAV-750:

   MASTER MOD. . . . . UNCAL Max ccw (OFF)

   HP355D:

   Attenuation Selected. 0dB

2. Adjust the spectrum Analyzer LINEAR SENSITIVITY control for a measured dc voltage at the VERTICAL OUTPUT jack of -500mV dc (V_{DET1}). (Check that trace is peaked on the display)

3. Select attenuation on the HP355D of 20dB. Note the dc voltage level at the analyzer's VERTICAL OUTPUT jack. (V_{DET2})

4. Calculate V_{off} where:

$$V_{off} = \frac{V_{DET2} - \alpha V_{DET1}}{1 - \alpha}$$

and $\alpha = V_{RF2}/V_{RF1}$* (i.e. α = attenuation)
for attenuation selected here (20dB) = 0.1

therefore:

$$V_{off} = \frac{V_{DET2} + 50.0mV\ dc}{0.9}$$

e.g., if V_{DET2} is -22.3mV dc,

$$V_{off} = \frac{-22.3mV\ dc + 50.0mV\ dc}{0.9}$$

$$= 30.78mV\ dc$$

5. Reset step attenuator to 0dB.

*See Calibration Chart provided with HP355D OPT H83

C. Percent Modulation Measurement and Calculation.

1. With the NAV-750(A) controls set as in A.1, 30Hz VOR modulation is selected. The front panel meter should indicate 30% modulation. (± 1.5%)

2. Using the Spectrum Analyzer's LINEAR SENSITIVITY control, adjust the measured dc level at the VERTICAL OUTPUT to:

$$-282.8\text{mV} + V_{off}$$

where:

V_{off} is that value calculated in B.4

3. Measure the ac level in mV at the VERTICAL OUTPUT jack (V_{rms})

4. Calculate percentage of modulation where:

$$\% \text{ Mod} = \frac{V_{rms} \times 2}{282.8\text{mV}}$$

OR

$$\% \text{ Mod} = \frac{V_{rms}}{2}$$

NOTE

$$V_{rms} = \% \text{ Mod} \times 2.0$$

e.g., 50% modulation is indicated by an ac level at the VERTICAL OUTPUT jack of (50.0 x 2.0) mV rms or 100.0mV rms.

Use the modulation controls and the Frequency Select Switch of the NAV-750,A to select necessary frequencies (with proper type and level of modulation) as required in the following step. (Refer to 5-61.6)

5. With front panel modulation controls in the Cal position, verify the results of the calculations in this procedure to agree with the NAV-750(A) front panel meter indication (Subject to the tolerances specified below):

Modulating Frequency	RF Frequency Range	Acceptable Level of Modulation (Absolute)	Acceptable Meter Reading
30Hz	VOR	30%(28.8-31.2)	±1.2% from Analyzer indication
9960Hz	VOR	30% (28.8-31.2)	±1.2% from Analyzer indication
90Hz	LOC	20% (19.2-20.8)	±0.8% from Analyzer indication
150Hz	LOC	20% (19.2-20.8)	±0.8% from Analyzer indication
90Hz	G/S	*40% (38.4-41.6)	±1.6% from Analyzer indication
150Hz	G/S	*40% (38.4-41.6)	±1.6% from Analyzer indication
1020Hz	COMM	30% (28.8-31.2)	±1.2% from Analyzer indication

*0-100 Meter scale selected. All others read on 0-30 scale.

The absolute value of the NAV-750(A) AM depth of modulation should be as indicated above in the column titled "Acceptable Level of Modulation (Absolute)."

SECTION VI

Calibration

6-1. Purpose.

6-2. The purpose of the following procedures is to bring all circuits of the NAV-750 into conformance with the Specifications in the event of a maladjustment or malfunction affecting the operation of the circuitry.

6-3. General.

6-4. The following procedures are not to be attempted before thorough familiarization with the operating procedures and the basic functional operation of the NAV-750 as shown on the Block Diagrams and the schematic diagrams.

6-5. ——— NOTE ———

Do not attempt any of the following procedures before an actual maladjustment or malfunction has been determined through the use of procedures outlined in the performance Evaluation Section. An attempt to improve performance by adjustment may actually result in a degradation of performance and perhaps damage to the unit.

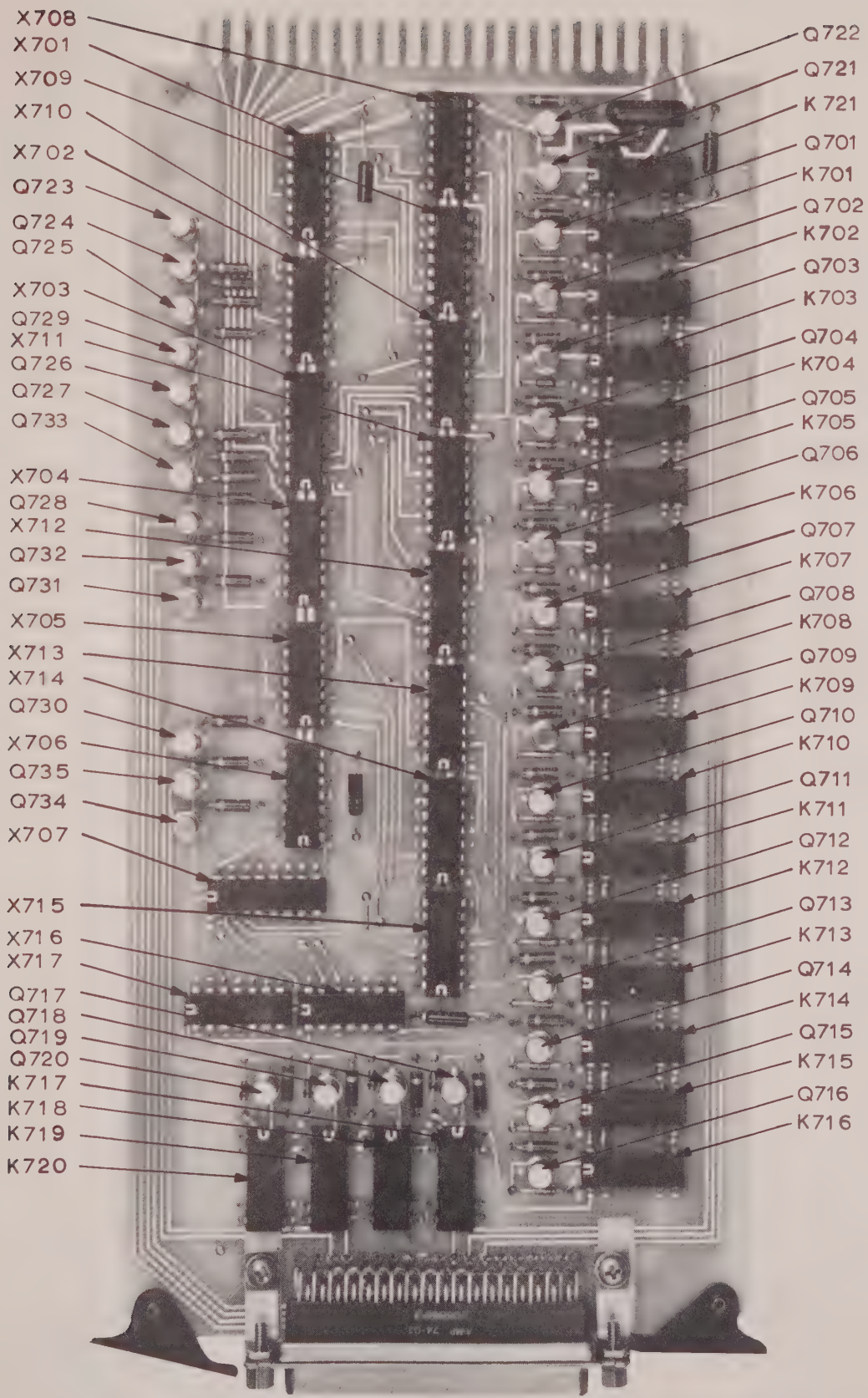
PC-7

Functional Check
Refer to Fig (6-1)

6-6. There is no calibration procedure associated with PC-7.

6-7. The sole function of this board is to remotely channel an external piece of equipment to the frequency selected by the operator of the NAV-750. BCD and ARINC (two out of five) coded information is presented via transistors and relays to the rear panel connector J8. This connector is attached directly to PC-7. Also present at J8 is an output indicating when the NAV-750 is on a localizer frequency. A full diagram of the coded information may be found on ~~page~~ fig 4-2. page 4-7

6-8. It should be noted that the frequency information is transmitted via PC-6, and that PC-7 will be totally inoperative without the use of PC-6. However, the operation of PC-6 is not affected by the absence of PC-7.



PC.-7 REMOTE CHANNELING BOARD
NAV.-750

FIG. 6-1

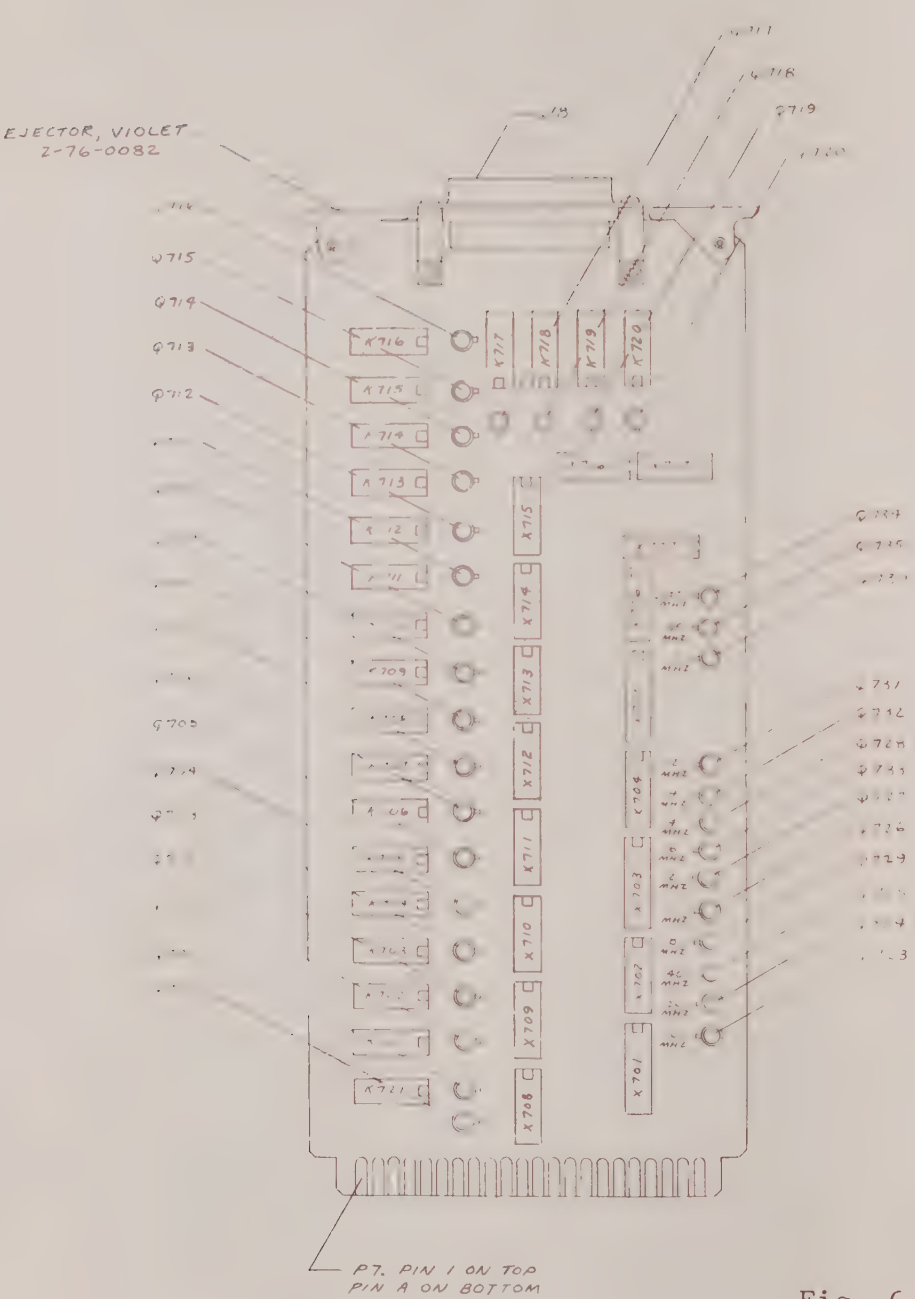


Fig 6-2

						VIOLET EJECTORS
	1	NAV-750	—	1	3-16 0018	REMOTE CHAN. BOARD
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION			LIST OF MATERIALS			

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

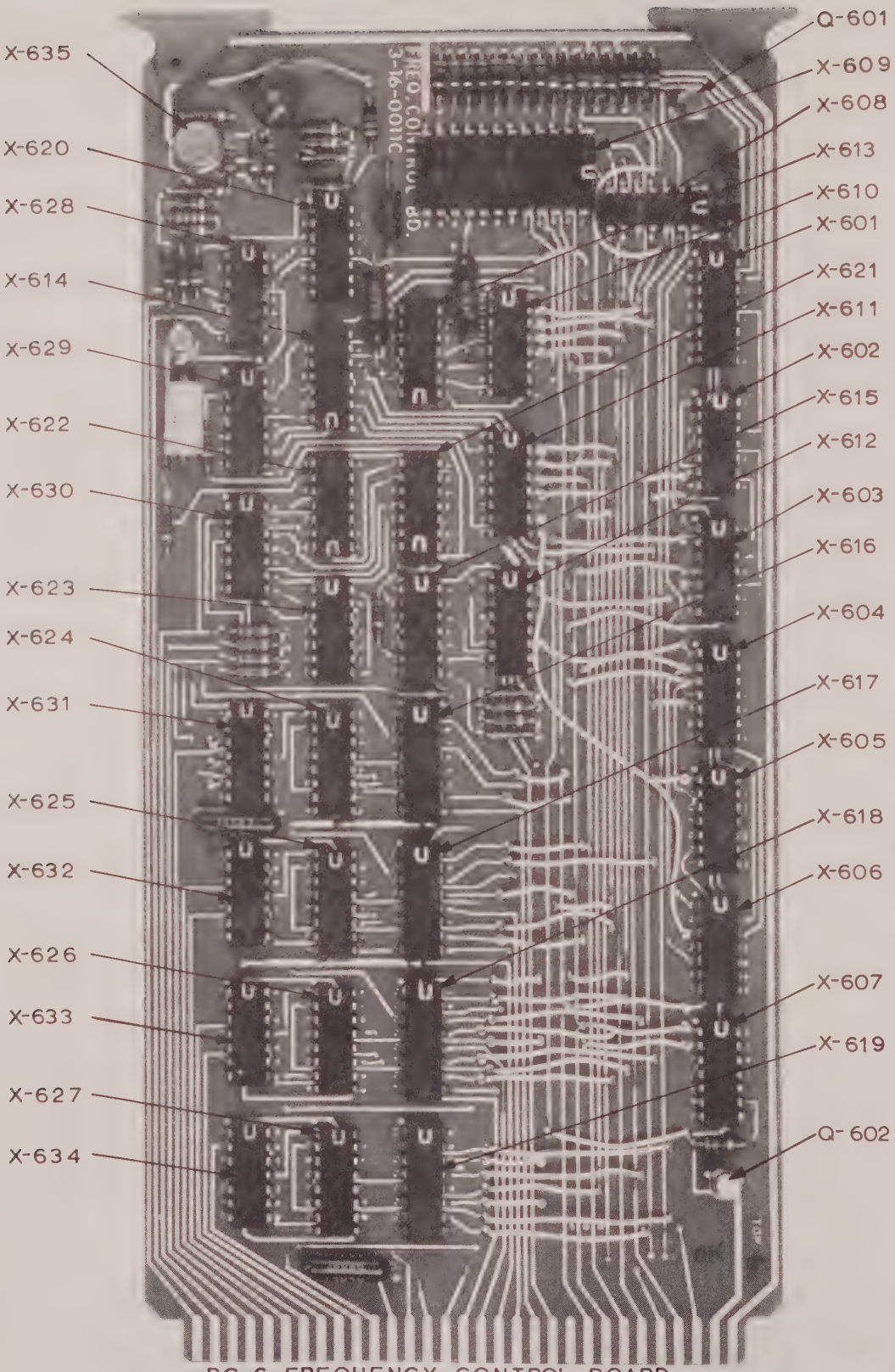
DRAWN JIG DATE 5/11/73
CHECKED M.H.L. DATE 2-16-73
APPROVED DATE 1-14-73

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE
REMOTE CHANNELING BOARD - MECH. LAYOUT NAV-750 PC-7

MATERIAL
TREATMENT
FINISH

SIZE
PART NUMBER 3-16-0018
REV
SCALE
WEIGHT
SHEET 2 OF 2



P.C.-6 FREQUENCY CONTROL BOARD
NAV-750

FIG. 6-3

PC-6
Functional Check

6-9. There are no adjustments associated with the operation of this board. Verification of proper performance should be made using the procedures outlined in the Performance Evaluation Section.

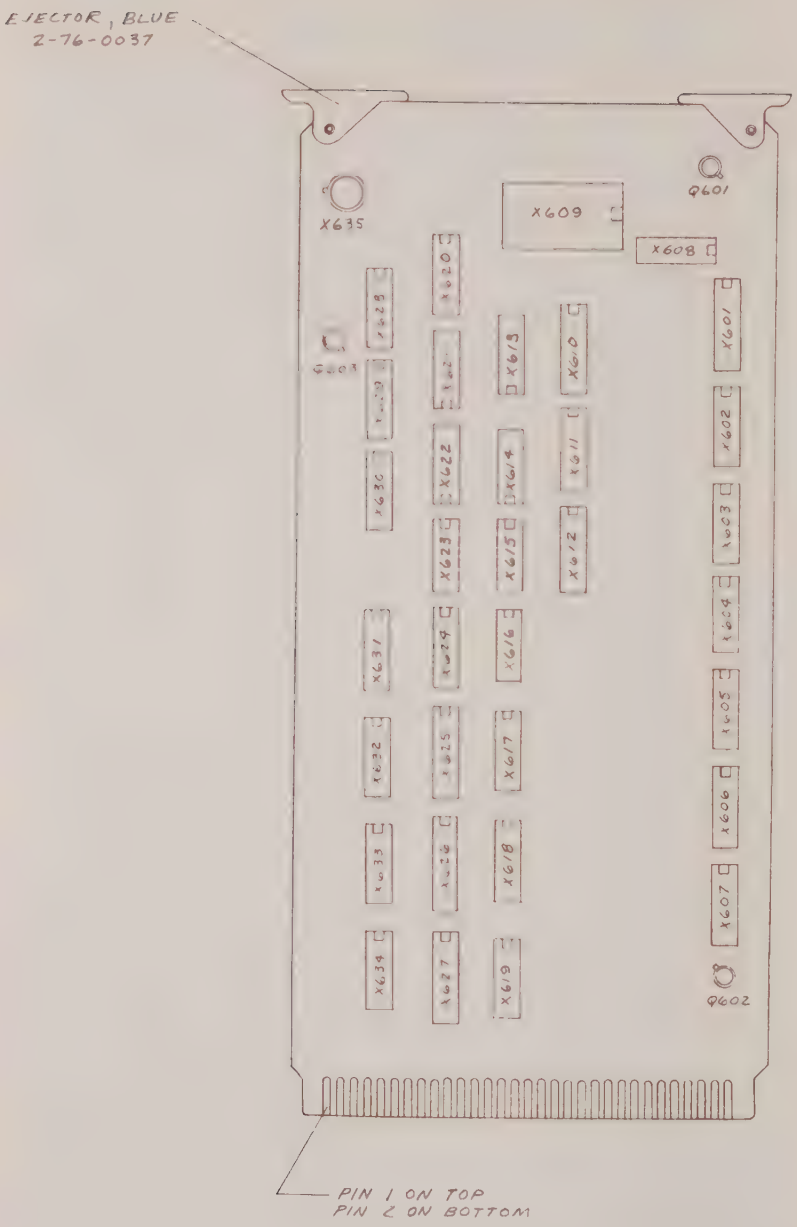


Fig 6-4

		NAV-750					BLUE EJECTORS
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO		DESCRIPTION
APPLICATION							LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 √
REMOVE ALL BURRS

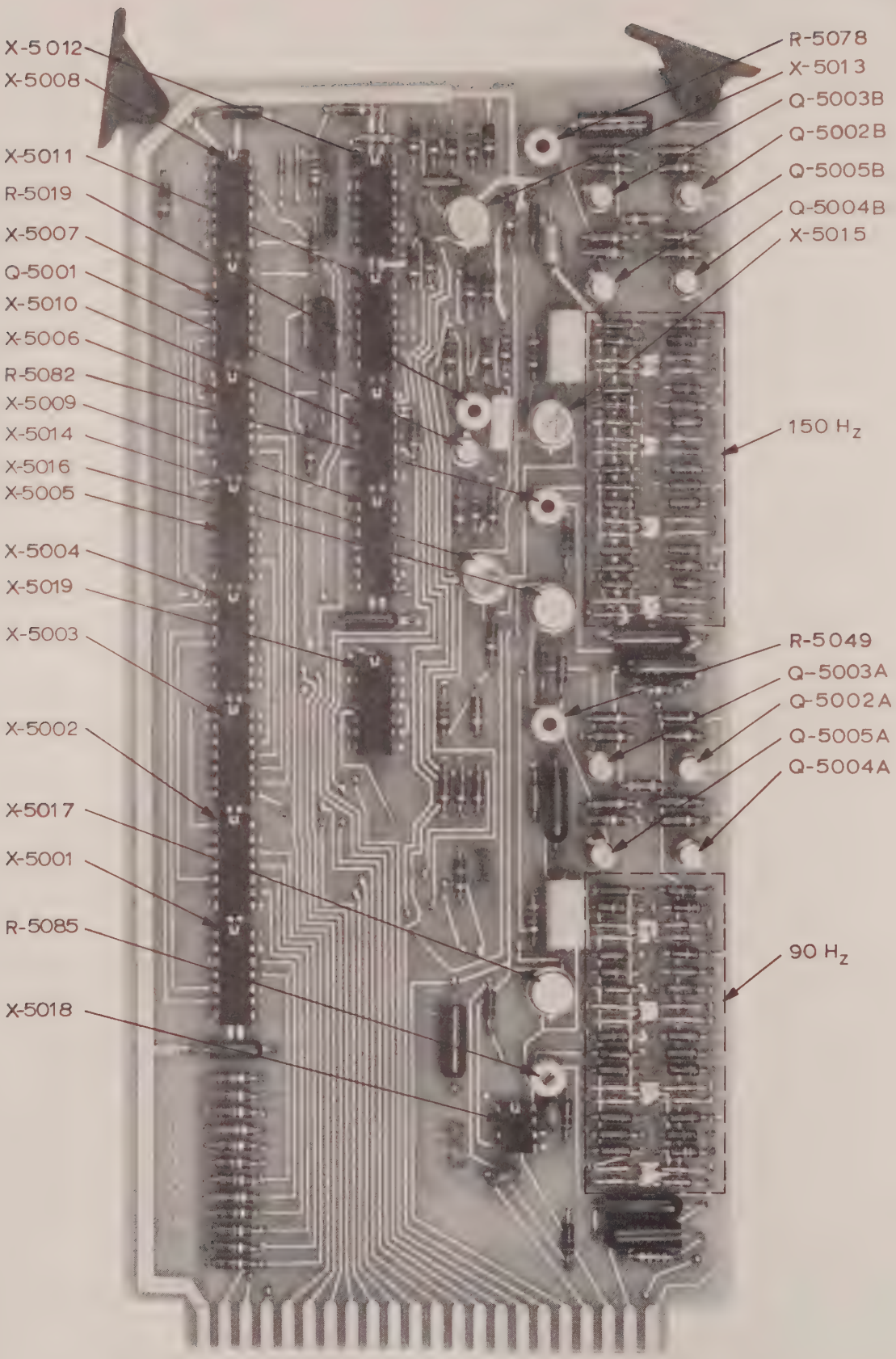
	DRAWN	DATE
	JIG	7/7/73
CHECKED	KK	7/23/73
APPROVED	QC	1-10-74

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: FREQ. CONTROL BD. MECH. LAYOUT NAV-750 PC-6

MATERIAL
TREATMENT
FINISH

SIZE	PART NUMBER	REV
C	3-16-0023	
SCALE 1:1	WEIGHT	SHEET 2 OF 2



P.C.-5 LOCALIZER BEARING CONTROL BOARD

NAV-750

FIG. 6-5

PC-5

Adjustment Procedure
(Localizer/Bearing Control Board)

6-10. Required Test Equipment and Fixtures.

Digital Voltmeter. . .	Fluke 8000A or equivalent
VOM. . . .	(20,000 ohms/volt minimum impedance)
Oscilloscope.	Dual-Trace, 20 MHz minimum frequency response
Audio Frequency Counter. . .	Resolution ± 0.1Hz
Audio Distortion Analyzer.	HP 334A or equivalent
Circuit Board Extender . . .	IFR P/N 2-16-0211

6-11. Introduction.

6-12. Purpose:

This procedure is primarily a guide for alignment of the circuitry associated with, and contained on PC-5. These procedures are normally initiated after improper operation has been noted, or after a malfunction affecting performance has been corrected.

Do not reset any adjustment before actual maladjustment or malfunction has been determined.

6-13. Initial Procedures:

PC-3, PC-4, and PC-5 function interdependently, and their operation should be verified using the procedures outlined in the Performance Evaluation Section.

6-14. ———— NOTE ————

Correct operation of PC-5 assumes correct operation of PC-3 and PC-4. The check and adjustment of the positive and negative power supplies is included for convenience. Any adjustment of either supply will cause a change in the distortion figures of any sine synthesizer in the NAV-750 generator.

6-15. Check and Adjustment of Pos and Neg 11V Power Supplies:

1. Remove PC-3 from the set under test, and place it on the extender board.

6-16. ——— NOTE ———

The adjustments of the positive and negative 11V power supplies will differ according to unit serial number and incorporation of the 11V Tracking Regulator modification on PC-3.

6-17. In those units with serial numbers below 178, the +11V supply is adjusted by R362, and the -11V supply is adjusted by R355 - both these adjustments are on PC-3. On later models (or those in which the PC-3 modification has been made), R362 serves as the only adjustment for both positive and negative supplies.

6-18. Most important in both cases is the balance of the absolute values of both supplies. They must be balanced to within .150V.

2. Adjust R362 (+11V) for +11V (±0.1V) at the collector (case) of Q314.

3. Adjust R355 (-11V) for -11V (±0.1V) at the collector (case) of Q313.

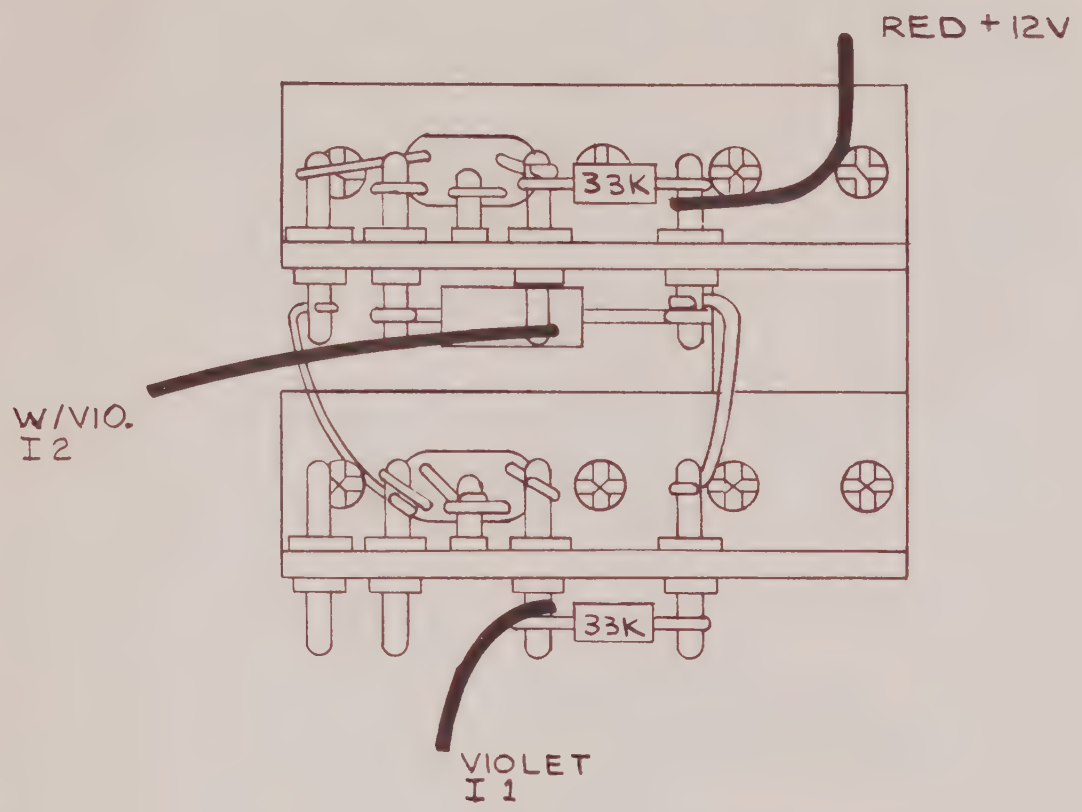
4. Verify the balance of the positive and negative supplies to be within the specified 150mV.

6-19. If any adjustment was made as in steps 2 and 3, refer to the adjustment procedure for PC-2 for readjustment of the distortion levels on the remaining Tone Sine Synthesizers.

6-20. Procedures:

6-21. 30° Pushbutton Bearing Select.

1. Verify the proper operation of the pushbuttons by the procedures outlined in the Performance Evaluation Section.


RED + 12V
33K
W/VIO.
I 2
33K
VIOLET
I 1

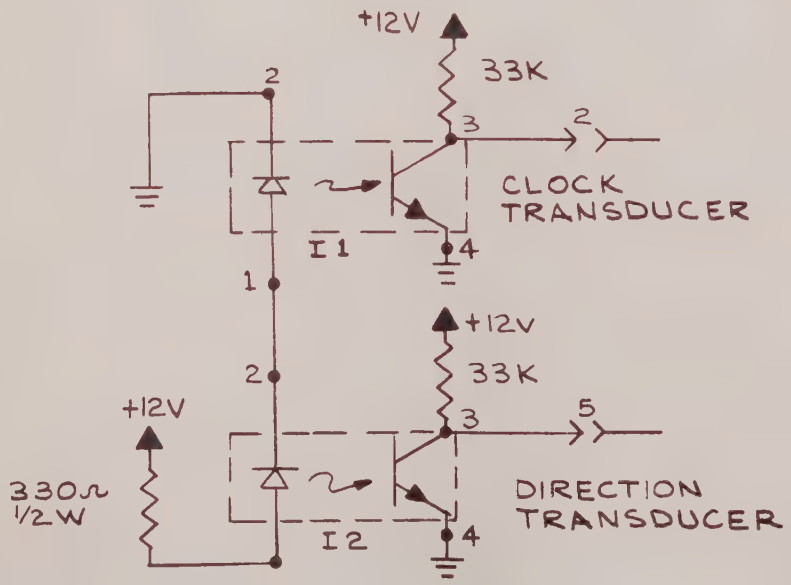

+12V
33K
2
3
2
CLOCK
TRANSDUCER
I 1
4
1
+12V
2
33K
+12V
3
5
330Ω
1/2W
DIRECTION
TRANSDUCER
I 2
4

FIG. 6-6

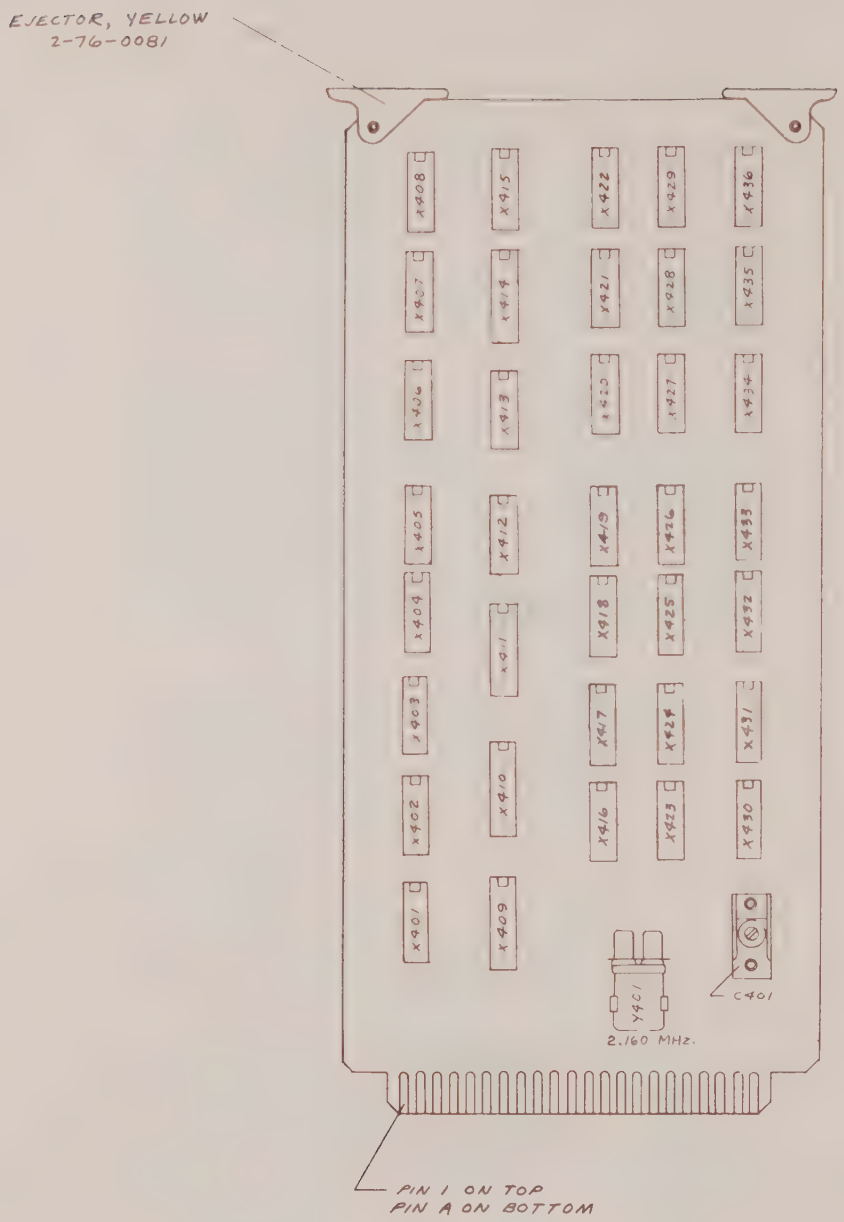


Fig 6-7

		NAV-750				YELLOW EJECTORS
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION			LIST OF MATERIALS			

TOLERANCES UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS APPLY AFTER FINISH DECIMALS: ± .005 ANGLES: ± 1/2° FRACTIONS: ± 1/64 SURFACE ROUGHNESS 125 ✓ REMOVE ALL BURRS	DRAWN JIG DATE 4/29/73 CHECKED DATE [illegible] 1/25/73 APPROVED DATE JE 1-17-74	INSTRUMENT FLIGHT RESEARCH CORPORATION WICHITA, KANSAS TITLE BEARING LOGIC BD MECH. LAYOUT NAV-750 PC-4
MATERIAL		SIZE C — PART NUMBER 3-16-0025 — REV
TREATMENT		SCALE 1:1 — WEIGHT — SHEET 2 OF 3
FINISH		

6-22. There are no adjustments for these operations. If trouble is encountered, refer to the Troubleshooting Section.

6-23. Variable Bearing Wheel Adjust. (Refer to Fig 6-6)

1. Using the Dual-Trace Oscilloscope, simultaneously monitor the outputs of the two photo-interrupter transducers. (The scope must be triggered by one of the two input signals).

2. Rotate the Variable Bearing Wheel and verify the signal level shift to be above +10.5V at the high level and below +2.5V at the low level. The waveforms present at these points should be approximate square waves with frequency in accordance with the speed of roation of the Variable Bearing Wheel.

   If improper operation is noted, refer to the Troubleshooting Section.

3. Simultaneously monitor the two transducer outputs after they have passed through the op-amp circuitry of X5013 and X5014 at the points labelled 1 and 2 on the schematic for PC-5.

4. Loosen the screws holding one of the transducer brackets, and position the bracket for an approximate 90° phase difference in the two input signals.

5. Check for correct increase and decrease in the indicated bearing during CW and CCW rotation of the Variable Bearing Wheel.

6. If the results in step 5 are opposite those desired, repeat steps 4 and 5 with either or both brackets to gain at 90° phase difference in the opposite direction. (Displaced 180° from the original setting).

7. Repeat step 5. If improper operation is noted, refer to the Troubleshooting section.

6-24. Sine Synthesizer Adjust:

6-25. 90Hz.

1. Check the output of the 90Hz Sine Synthesizer at the rear panel jack J17 (90Hz).

There is no adjustment for the frequency of this signal. If incorrect frequency is noted, refer to the Troubleshooting section.

2. Alternately adjust R5049 (90Hz Amp) and R5085 (90Hz Cent) for minimum distortion of the 90Hz sine wave output. (Must be less than 0.5%)

6-26. 150Hz.

1. Check the output of the 150Hz Sine Synthesizer at the rear panel jack J19 (150Hz).

   There is no adjustment for the frequency of this signal. If incorrect frequency is noted, refer to the Troubleshooting Section.

2. Alternately adjust R5082 (150Hz Cent) and R5078 (150Hz Amp) for minimum distortion. (Must be less than 0.5%).

6-27. .05° Bearing Select Adjust. Control Setting:

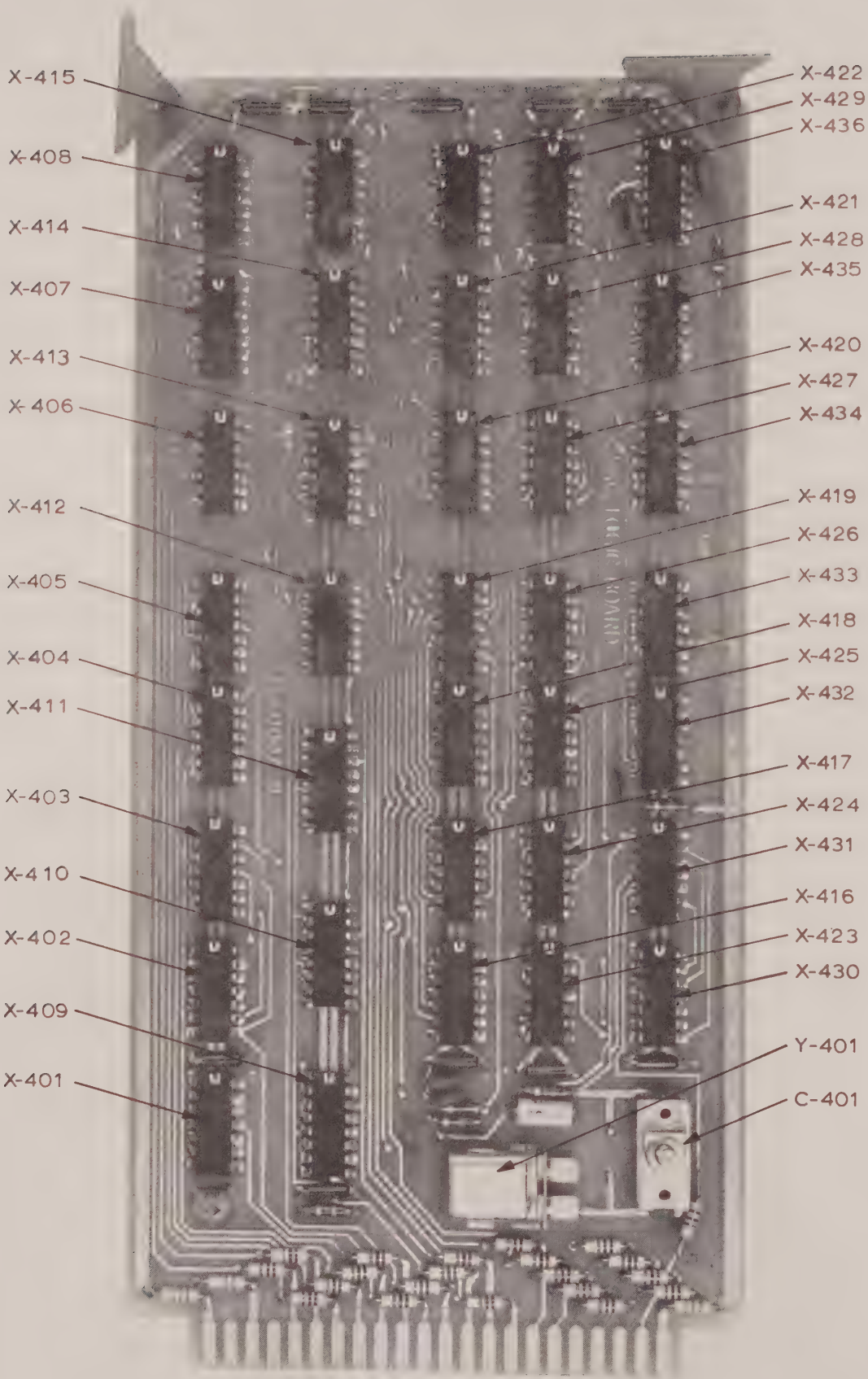
.01° - 05° Select Switch. . . . . 05°

Counter Mode Switch. . . . . .BEARING

1. Connect an oscilloscope probe to pin 2 of X5010 on PC-5.

2. Rapidly rotate the Bearing Wheel and adjust R5091 (.05° Adjust) for a scope display of a pulse train of exactly five pulses approximately 3.2V in amplitude and with 50us spacing.

3. Rotate the Bearing Wheel and verify the NAV-750 counter increasing or decreasing in .05° steps.



P.C.-4 BEARING LOGIC BOARD
NAV-750

FIG. 6-8

PC-4

Functional Check and Adjustment
(Bearing Logic Board)

6-28. Required Test Equipment and Fixtures.

RF Frequency Counter. .120 MHz minimum frequency response, minimum sensitivity of -10 dBm, time base accuracy of .002%

Oscilloscope. . . . . Dual Trace, minimum 40 MHz minimum frequency response, (typically DUMONT 1052)

6-29. Introduction.

As explained in the VOR portion of the Theory of Operation Section, PC-4 and PC-5 function interdependently. The only adjustment on PC-4 is the setting of the 2.16 MHz clock frequency. From this circuitry come the digitally derived 30Hz, 90Hz, and 150Hz signals. After verification of correct operation of these circuits, the functional check of the board consists of those operational checks outlined in the Performance Evaluation Section of the Manual.

6-30. Procedure:

1. With PC-4 on it's extender board, connect the RF frequency counter to Pin 6 of X431.

2. Adjust C401 for an indication on the counter of 2.16 MHz (±.02%).

3. Refer to the schematic diagram of PC-4 and connect the oscilloscope to the output point of the 30Hz REF signal. Verify the signal to be exactly 30Hz and to be a symmetrical waveform with a 50-50 duty cycle. Verify the positive portion of the waveform to have a time duration equal to that of the negative portion (±1.0us) using the delayed sweep function of the oscilloscope.

4. Verify the frequency and 50-50 duty cycle of the 30Hz VAR, 90Hz and 150Hz in the manner explained in step 3.

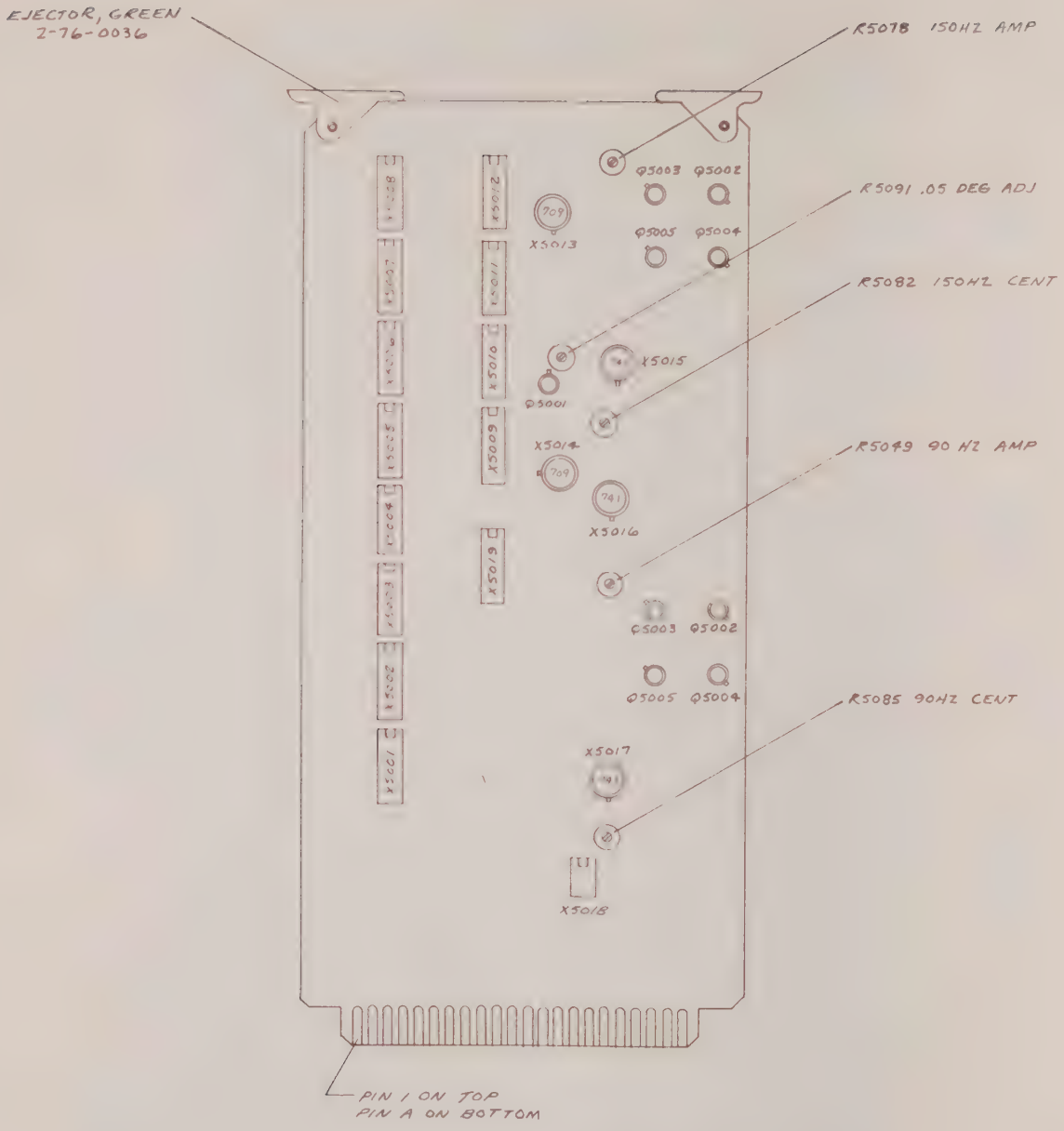
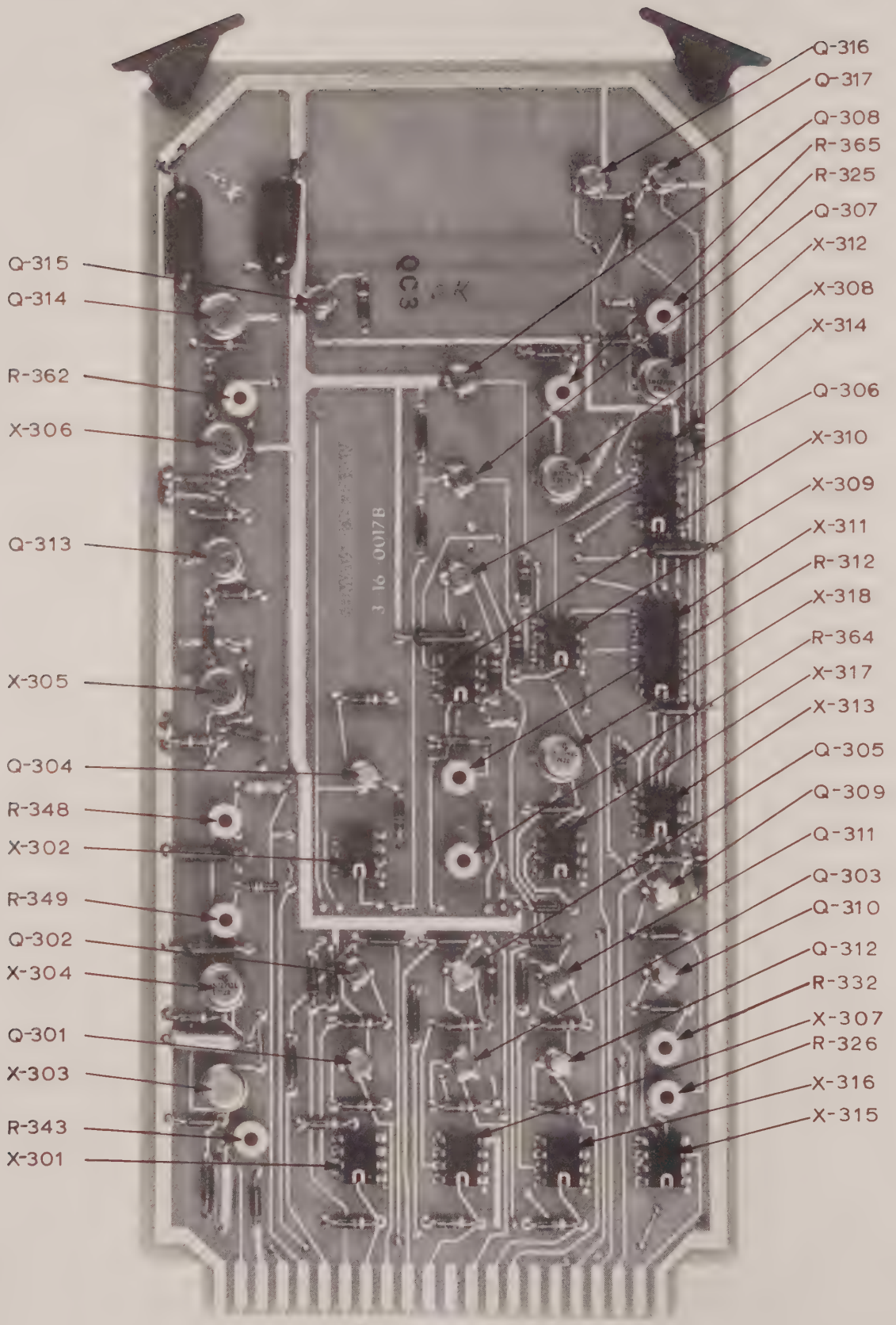


Fig 6-9

		NAV-750				GREEN EJECTORS
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION			LIST OF MATERIALS			

TOLERANCES UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS APPLY AFTER FINISH DECIMALS: ± .005 ANGLES: ± 1/2° FRACTIONS: ± 1/64 SURFACE ROUGHNESS 125 REMOVE ALL BURRS	DRAWN JIG DATE 4/21/73 CHECKED RK DATE 7/25/73 APPROVED DATE 1-17-74	INSTRUMENT FLIGHT RESEARCH CORPORATION WICHITA, KANSAS TITLE LOCALIZER/BRG CONTROL MECH LAYOUT NAV-750 PC-5
MATERIAL		SIZE C — PART NUMBER 3-16-0024 — REV
TREATMENT		
FINISH		SCALE 1:1 — WEIGHT — SHEET 3 OF 3



P.C.-3 TONE SUMMATION
BOARD
NAV-750

FIG. 6-10

PC-3

Check and Adjustment Procedure
(Tone Summation Board)

6-31. Required Test Equipment and Fixtures.

Digital Voltmeter. . .	Fluke 8000A or equivalent
VOM. . . .	(20,000 ohms/volt minimum impedance)
Oscilloscope.	Dual-Trace, 20 MHz minimum frequency response
AC Differential Voltmeter. . .	Fluke model 883AB or equivalent
Circuit Board Extender. . . .	IFR P/N 2-16-0211

6-32. Introduction.

6-33. Purpose:

This procedure is a guide for the alignment of the circuitry on and associated with PC-3. Before making any of the adjustments in this procedure, an actual malfunction or maladjustment must be determined using the procedures outlined in the Performance Evaluation Section.

6-34. Initial Procedures:

Perform those tests outlined in the Performance Evaluation Section. PC-3 should be placed on the circuit extender board and the NAV-750 should be energized as per normal operation.

6-35. Check and Adjustment of Pos and Neg 11V Power Supplies:

6-36. ———— NOTE ————

The adjustments of the positive and negative 11V power supplies will differ according to unit serial number and incorporation of the 11V Tracking Regulator modification on PC-3.

6-37. In those units with serial numbers below 178, the +11V supply is adjusted by R362, and the -11V supply is adjusted by R355. On later models (or those in which the PC-3 modification has been made), R362 serves as the only adjustment for both positive and negative supplies.

6-38. Most important in both cases is the balance of the absolute values of both supplies. They must be balanced to within .150V.

1. Adjust R362 (+11V) for +11.0V (±0.1V) at the collector (case) of Q314.

2. Adjust R355 (-11V) for -11.0V (±0.1V) at the collector (case) of Q313.

3. Verify the balance of the positive and negative 11V supplies to be within the specified 150mV.

6-39.

———— NOTE ————

If any adjustment was made in step 1 or 2, refer to the adjustment procedures for PC-2 and PC-5 for re-adjustments of the distortion levels on the remaining tone sine synthesizers.

6-40. DC Offset Measurement and Adjustment: Control settings:

Frequency Select Switch. . . . . 108.0 MHz
30Hz . . . . . UNCAL max CCW
MASTER MOD . . . . . Cal
9960Hz . . . . . UNCAL max CCW

1. Connect test equipment as in Figure 6-29.
2. Remove the Tone Summation Board (PC-3) from the NAV-750.
3. Measure and note the DEMOD VAC value at J23 (DEMOD).
4. Insert PC-3 in the NAV-750.
5. Measure the DEMOD VAC and adjust R325 to obtain a value equal to that obtained in step 3 (± 10.0mV).

6-41. Tone Modulation Level Adjustments: Control settings:

Frequency Select Switch. . . . . 108.0 MHz
9960Hz . . . . . UNCAL max CCW
All other tone level controls. . . . . Cal

1. Using the procedure on page 5-28, adjust R364 (30Hz) for an indicated depth of modulation of 30% (± 1.2%)

Control settings:

9960Hz . . . . . Cal
30Hz . . . . . UNCAL max CCW

2. Adjust R312 (9960Hz) for an indicated depth of modulation of 30% (± 1.2%).

Control settings:

Frequency Select Switch. . . . . .118.00 MHz
All tone level controls. . . . . Cal

3. Adjust R365 (1020Hz) for an indicated depth of modulation of 30% (± 1.2%).

6-42. Localizer and Glide Slope DDM Adjustments.

6-43. Localizer DDM Centering Adjust: Control settings:

LOC/GS Switch. . . . . .LOC
Frequency Select Switch. . . . . .108.0 MHz
G/S DDM Switch 0
LOC DDM Switch 150Hz
All tone level controls. . . . . .Cal

1. Using the procedure on page 5-28, adjust R326 (Localizer) for an indicated depth of modulation of 20% (± 0.8%).

2. Measure and note the DEMOD VAC value at J23 (DEMOD).

3. Select 90Hz with the LOC DDM switch and adjust the front panel LOC CAL control for the same voltage reading as obtained in step 2. (± 1.0mV) Refer to page 5-21.

6-44. 0-30 Meter Scale Adjust: Control settings:

Meter Function Switch. 0-30

1. Adjust R348 (30%) for a front panel meter reading equal to value read in 6-43.1 (± 0.8%)

6-45. Glide Slope DDM Centering Adjust. Control settings:

Frequency Select Switch. . . . . 108.10 MHz
LOC DDM Switch 0
G/S DDM Switch 150Hz
LOC/GS Switch. . . . . GS

1. Using the procedure on page 5-28, adjust R332 (GS) for an indicated depth of modulation of 40% (± 1.6%)

2. Measure and note the DEMOD VAC value at J23 (DEMOD)

3. Select 90Hz with the G/S DDM switch and adjust the front panel GS CAL control for the same voltage reading as obtained in step 2. (± 1.0mV) Refer to page 4-23.

6-46. 0-100 Meter Scale Adjust. Control settings:

Meter Function Switch. 0-100

1. Adjust R349 (100%) for a front panel meter reading equal to the value read in 6-45.1 (± 1.6%)

6-47. RF Meter Function: Control settings:

Meter Function Switch. . . . . RF

1. Adjust R343 (R F) for a center scale indication on the front panel meter of the NAV-750. (± 1½ needle's width).

2. Verify the needle remains centered as the NAV-750 is channeled throughout it's entire frequency range.

6-48. External Modulation Check: Control settings:

Frequency Select Switch . . . . . 108.0 MHz

9960Hz. . . . . UNCAL Max CCW (0)

MASTER MOD. . . . . Cal

Meter Function Switch 0-100

1. Connect the 30Hz REF output (J22) to the EXT MOD jack (J18).

2. Verify the front panel meter reading to be approximately 29% (28.5-31.5%).

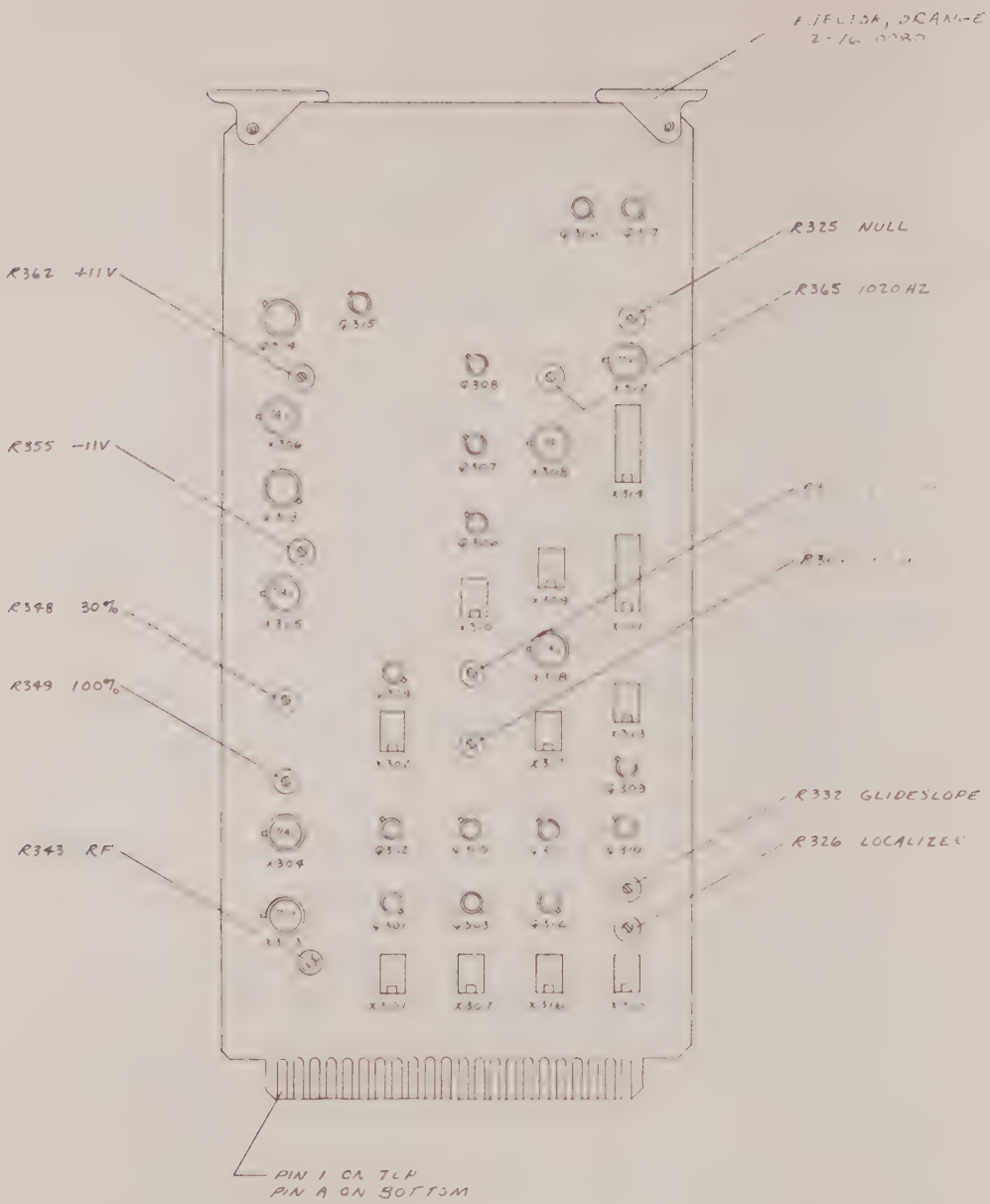


Fig 6-11

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION			LIST OF MATERIALS			

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

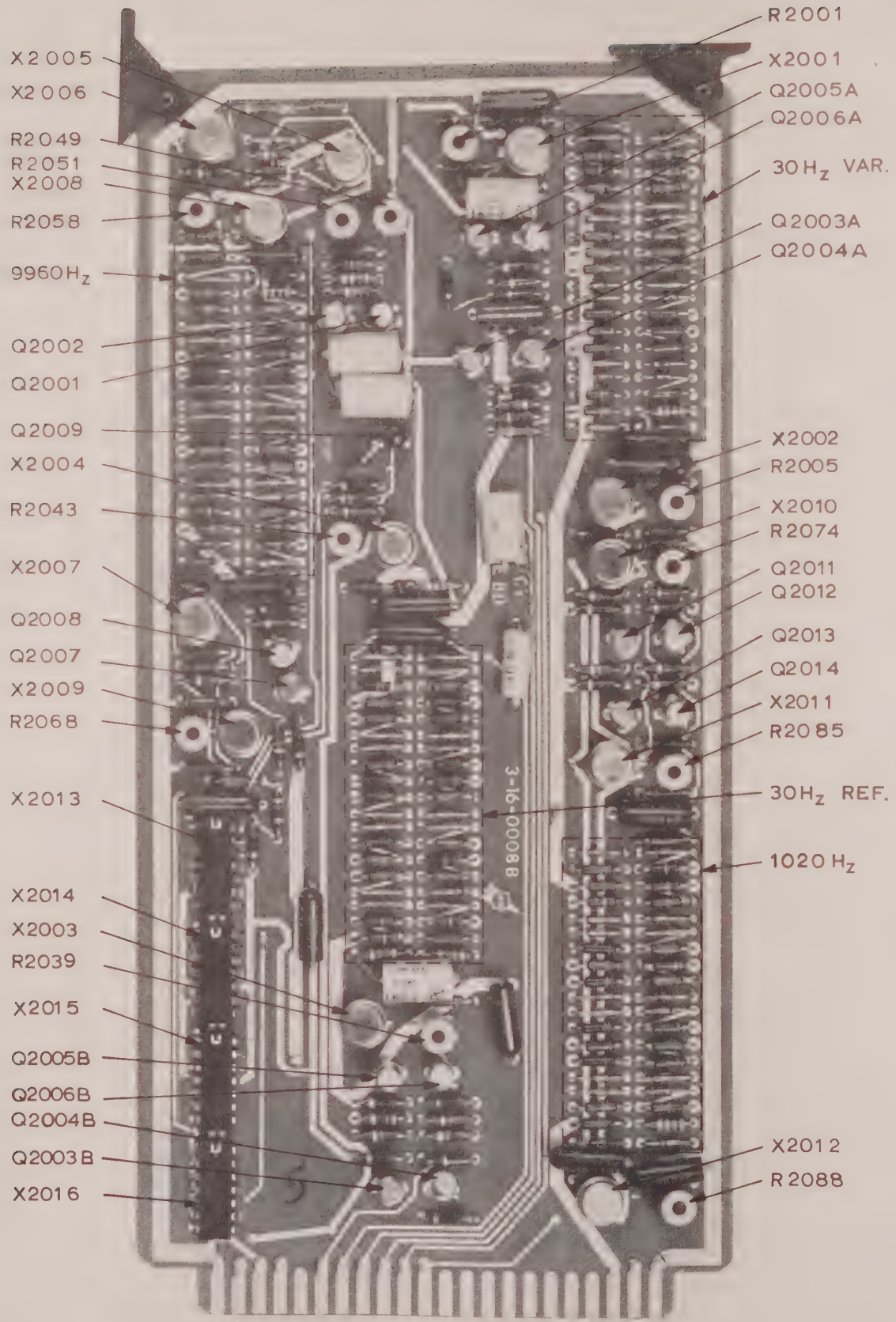
DRAWN JIG DATE 18 73
CHECKED DATE
APPROVED DATE 1-17-74

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE
TONE SUMMATION BL
MECH. LAYOUT
NAV-750

MATERIAL
TREATMENT
FINISH

SIZE C
PART NUMBER 3-16-0020
REV
SCALE 1:1
WEIGHT
SHEET OF



PC.-2 30Hz SINE BOARD
NAV-750

FIG. 6-12

Adjustment Procedure (30Hz Sine Board)

6-49. Required Test Equipment and Fixtures

Digital Voltmeter.	Fluke 8000A or equivalent
VOM	.20,000 ohms/volt minimum impedance
Oscilloscope	Dual Trace, 10 MHz minimum frequency response
Audio Frequency Counter. . . .	Resolution ±0.1Hz
Audio Distortion Analyzer.	HP 334A or equivalent
Circuit Board Extender. . . .	IFR P/N 2-16-0211

6-50. Introduction.

6-51. Purpose:

This procedure is primarily a guide for alignment of the tone processing circuitry on PC-2 after improper operation has been noted, or after a malfunction affecting performance has been corrected. The operation of PC-2 assumes correct operation of the positive and negative 11V supplies on PC-3 and the direct digital syntheses circuitry from the 2.16 MHz oscillator on PC-4 and PC-5.

6-52. Initial Procedures:

Verify the performance of the positive and negative 11V supplies of PC-3, and the tone generation circuitry of PC-4 and PC-5 using the procedures outlined in the Performance Evaluation Section.

Remove PC-2 from the NAV-750 and place PC-2 on its extender board.

Energize the set and agin verify the performance of the circuitry affecting the performance of PC-2.

6-53. Procedures:

6-54. Sine Synthesizer Adjust:

6-55. 30Hz REF

1. With the Distortion Analyzer connected to the rear panel jack J22 (30Hz REF), alternately

adjust R2039 (30Hz REF AMPL) and R2043 (30Hz REF CENT) for minimum distortion. Must be less than 0.5%.

6-56. 30Hz VAR

1. Connect the Distortion Analyzer to the rear panel jack J24 (30Hz VAR), and alternately adjust R2005 (30Hz VAR CENT) and R2001 (30Hz VAR AMPL) for minimum distortion. Must be less than 0.5%.

6-57. 1020Hz

1. Connect the Audio Frequency Counter to the rear panel jack J16 (1020Hz), and adjust R2085 (1020Hz FREQ) for an approximate 1020Hz indication on the counter.

2. Connect the Distortion Analyzer to the same jack (J16), and adjust R2088 (1020Hz CENT) for minimum distortion.

3. Adjust the 1020Hz AMPL pot (R2074) for minimum distortion.

6-58. ———— NOTE ————

Use of the HP334A Distortion Analyzer has been chosen here because of the automatic operation feature. Varying the 1020Hz AMPL pot will change the frequency of the generator. See NOTE below.

4. Again connect the Audio Frequency Counter to the 1020Hz jack (J16), and check the frequency of the signal.

5. Adjust R2085 (1020Hz FREQ) for an indication on the counter of 1020Hz (±2.0Hz).

6. Again connect the Distortion Analyzer and, if necessary, adjust R2088 (1020Hz CENT) for minimum distortion. Must be less than 0.5%.

6-59. ———— NOTE ————

The FREQ and AMPL controls are interactive, and the adjustments must be made so that distortion is within specifications while the frequency remains 1020Hz (±2.0Hz).

6-60. 9960Hz

1. Remove the FM portion of the 9960Hz tone by adjusting R2049 (9960Hz DEV) fully CCW.

2. Connect the Audio Frequency Counter to the rear panel jack J20 (9960Hz), and monitor the 9960Hz tone frequency.

3. Refer to the schematic diagram for PC-2 and connect an oscilloscope probe to the test point labelled 3 (junction of R2047 and Q2002). Select DC scope input.

4. Adjust R2051 (9960Hz FREQ) fully CCW and adjust the scope controls to show a DC level swing. This "swinging" DC level is the tune line of the phase-lock system for the 9960Hz. Position this display with the scope controls to be vertically centered on the screen.

5. Adjust R2051 (9960Hz FREQ) to bring the "swinging" DC level on the scope to a halt in a vertically centered position. This should represent a phase-lock condition of the 9960Hz tone generating system.

6. Verify the frequency of the generated tone to be 9960Hz with the Audio Frequency Counter.

7. Connect the Distortion Analyzer to J20 (9960Hz) and adjust R2058 (9960Hz CENT) for minimum distortion of the now phase-locked signal.

8. Adjust the 9960Hz AMPL pot (R2068) while monitoring the tune line on the scope, for a very slight movement of the DC level displayed on the scope (in either direction). Use the 9960Hz FREQ pot (R2051) to again center the tune line display on the scope. Continue the process using the FREQ and AMPL controls to adjust for minimum distortion while maintaining a centered scope display of the tune line.

9. Repeat Step 7.

10. Reset the FM deviation of the signal with R2049 using the procedure given in the Performance Evaluation Section. (Page ~~5-18~~ 5-17) Δt = 48.5us.

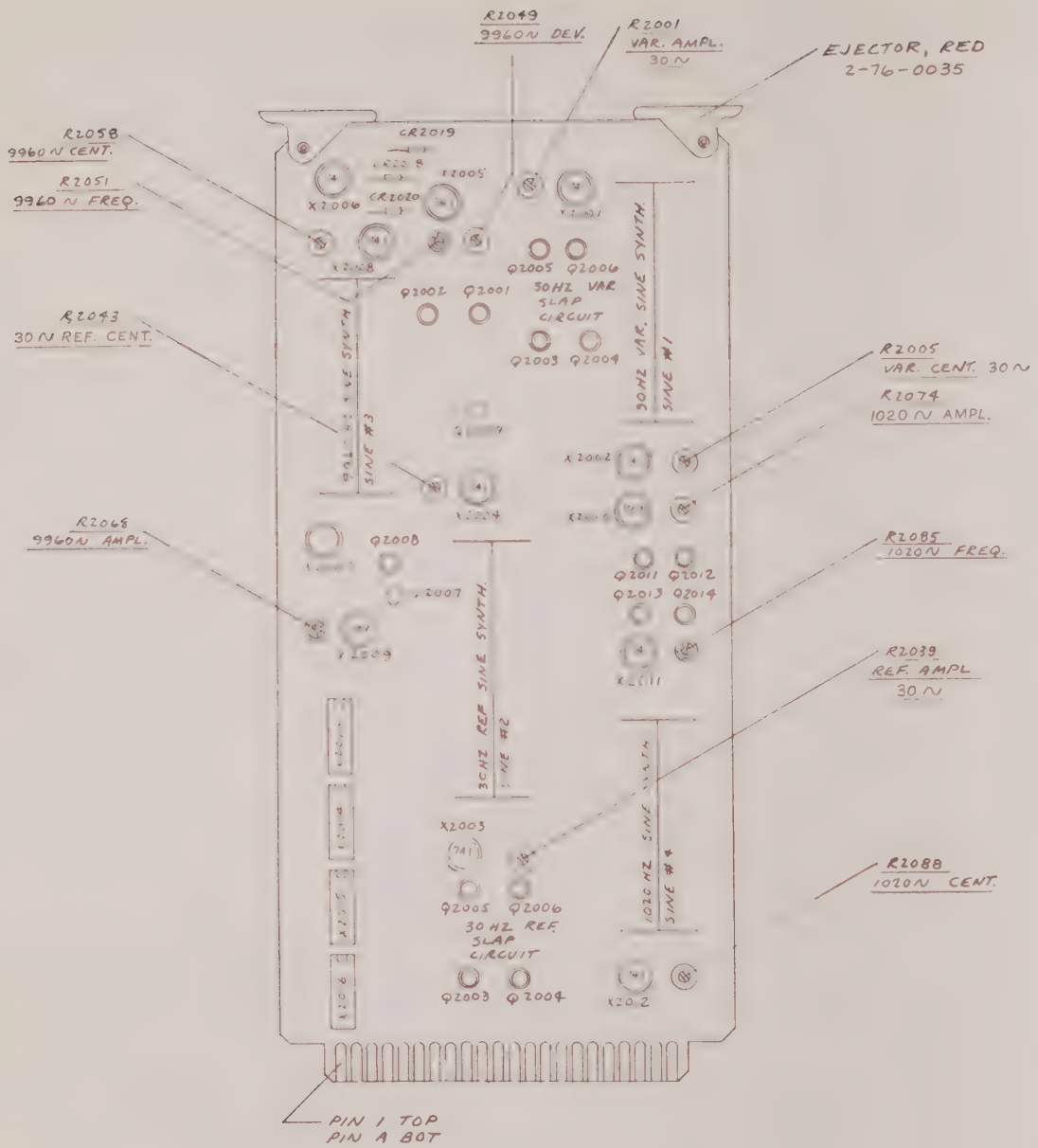
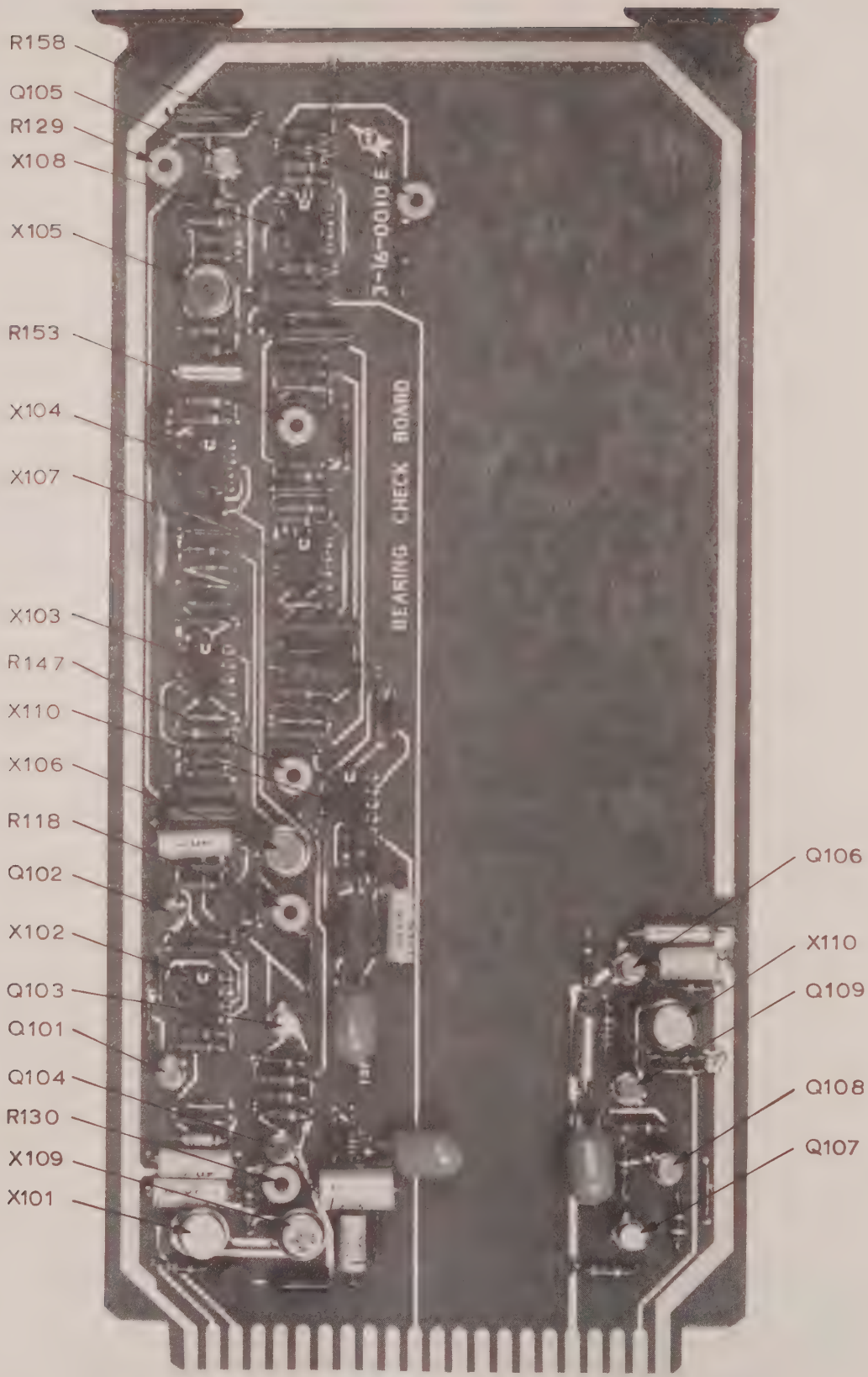


Fig 6-13

							RLU EJECTORS
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION	
APPLICATION						LIST OF MATERIALS	

TOLERANCES UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS APPLY AFTER FINISH DECIMALS: ± .008 ANGLES: ± 1/2° FRACTIONS: ± 1/64 SURFACE ROUGHNESS 125 ✓ REMOVE ALL BURRS	DRAWN JIG 5/14/73 CHECKED RR 7/25/73 APPROVED [illegible] 22675	INSTRUMENT FLIGHT RESEARCH CORPORATION WICHITA, KANSAS TITLE 30 HZ SINE BD, MECH. LAYOUT NAV-750 PC-2
MATERIAL TREATMENT FINISH		SIZE C · PART NUMBER 3-16-0015 · REV SCALE · WEIGHT · SHEET 2 OF 2



P.C.-1 BEARING CHECK BOARD
NAV-750

FIG.6-14

Adjustment Procedure (Bearing Check Board)

6-61. Required Test Equipment and Fixtures.

Digital Voltmeter.	Fluke 8000A or equivalent
VOM	20,000 ohms/volt minimum impedance
Oscilloscope.	20 MHz minimum frequency response
Audio Frequency Counter. . . .	Resolution ±0.1Hz

6-62. Introduction.

6-63. Purpose:

This procedure is primarily a guide for alignment of the bearing verification circuits on PC-1. The check procedures for these circuits are contained in the Performance Evaluation Section under the heading of Metering Circuits. The circuitry on PC-1 generates the information displayed on the front panel meter in the ZERO and BRG positions.

6-64. ——— NOTE ———

The circuitry on PC-1 is intended to verify the performance of the NAV-750's own generated VOR signals. The following adjustments are done with the assumption the VOR bearing generation circuits are calibrated within specifications.

6-65. The following adjustments on PC-1 in no way affect the absolute calibrated accuracy of the NAV-750.

6-66. Initial Procedures:

1. Perform those tests outlined in the Performance Evaluation Section as referred to in the Introduction to this procedure.

2. Remove the top cover of the set to gain access to PC-1.

Control settings:

Frequency Select Switch. . . .	Frequency in VOR range
All Tone Controls.	.Cal
Counter Mode Switch.	.BEARING
Bearing ZERO Control	Mid-Position
Selected Bearing.	90°
Meter Function Switch	.ZERO
AUTO-MANUAL Switch.	.MANUAL
ΔF Control	CAL

6-67. Procedures:

1. Check the waveform at the DEMOD jack (J23) and verify it to be a typical VOR signal--9960Hz frequency modulated by the 30Hz REF superimposed with the 30Hz VAR of an amplitude equal to the 9960Hz.

2. Adjust R129 (+11V) to indicate +11V (+0.20V) at the collector (case) of Q105.

3. Observe the DC level at Pin 1, X104, with the oscilloscope and verify it to be half the adjusted supply voltage (±0.1V).

4. Adjust R118 (Frequency) until the DC level of the 30Hz sine wave at TP 3 is equal to the value of the DC level checked in step 3.

5. Adjust the Zero Trim pot (R153) for a center scale (0°) indication on the front panel meter.

6. Set the Meter Function Switch to BRG.

7. Alternately select the TO and FROM positions of the TO-FROM select switch, and adjust the Phase control (R130) to achieve the same meter reading—not necessarily zero--in both positions of the switch.

8. Adjust the Balance control (R147) for a center scale (0°) front panel meter indication.

9. Set the Meter Function Switch to the ZERO position and re-adjust the Zero Trim pot (R153) if necessary.

10. Set the meter function switch to BRG and re-adjust the balance control as in step 8.

11. Adjust the variable bearing wheel for a meter deflection to the right and an indicated bearing 0.5° from the selected bearing.

12. Adjust the deflection pot (R158) for an exact full scale deflection to the right.

13. Select a bearing of 270° and verify the meter needle to return to a center scale position (±0.05°).

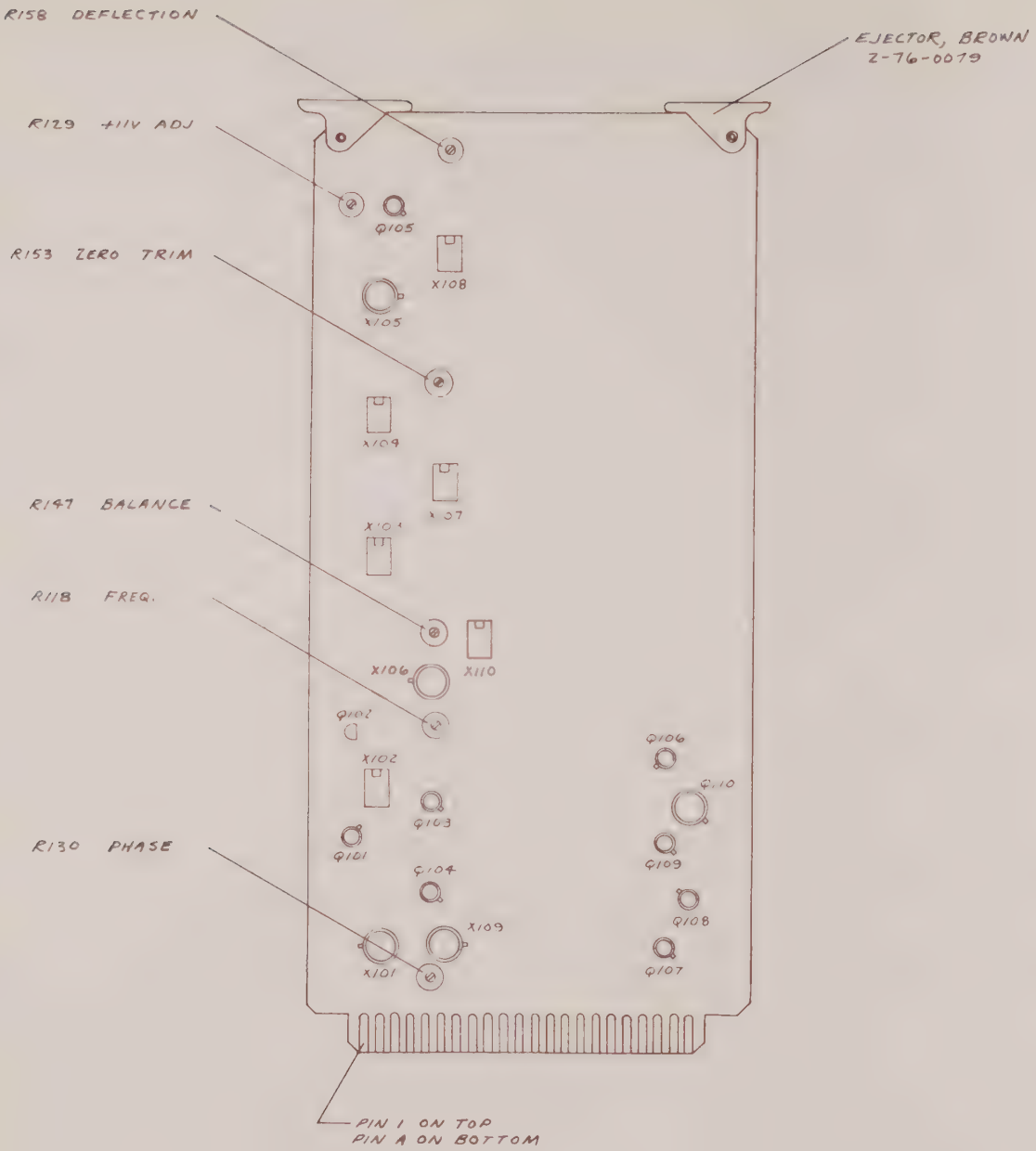


Fig 6-15

		NAV-750				BROWN EJECTORS
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION						LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

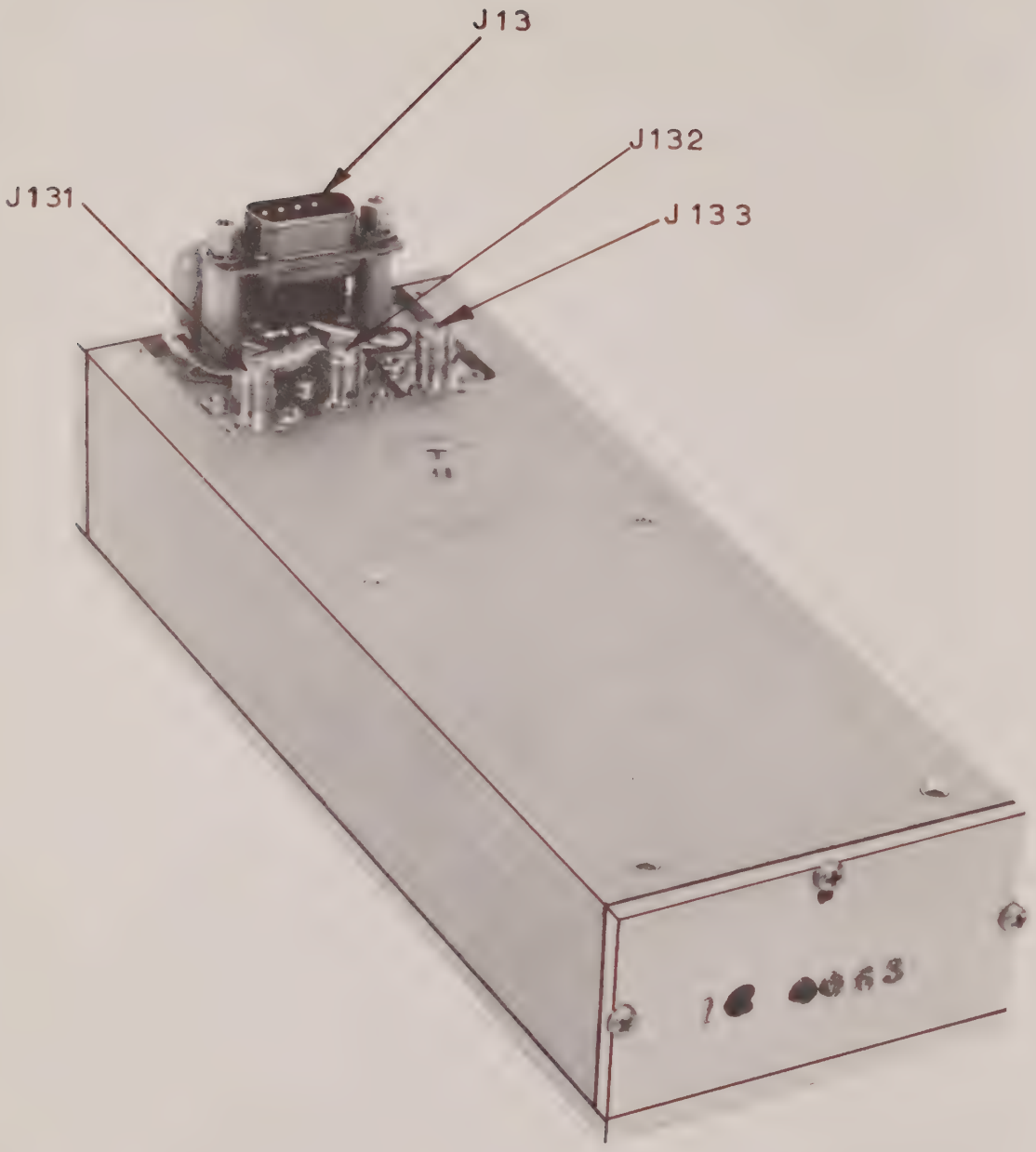
MATERIAL
TREATMENT
FINISH

DRAWN JIG 6/13/73
CHECKED RR 7/25/73
APPROVED [illegible] 1-17-74

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: BEARING CHECK BOARD MECH. LAYOUT NAV-750 PC-1

SIZE C | PART NUMBER 3-16-0021 | REV
SCALE 1:1 | WEIGHT | SHEET 2 OF 2



OSCILLATOR ASSEMBLY
NAV-750

FIG. 6-16

Standard Low/High Band Oscillator Adjust

6-68. Required Test Equipment and Fixtures

VOM.	.Fluke 8000A or equivalent
Oscilloscope	.Dual-Trace, minimum frequency response (typically DUMONT 1052)
RF Power Meter . .	.General Microwave 460B with 1mW power head or equivalent
Wave Analyzer. . .	HP 3590 with 3593 plug-in or equivalent

6-69. Preliminary Set-Up.

Remove the oscillator assembly from the NAV-750, and remove the access cover of the oscillator. Refer to Figure 6-17.

Connect the oscillator and other RF assemblies as shown in Figure 6-32.

6-70. 11V Regulator Adjust.

1. Adjust R1303 (+11V Adjust) for an indication of +11.0V ±0.1V at the collector (case) of Q1301.

6-71. Oscillator Frequency Adjust.

6-72. ——— NOTE ———

Proper Phase LOCK operation requires a DC level setting of the tune line approximately two-thirds the most positive value obtained in the Integrator Centering Adjustment. There may be some slight oscillation on the tune line, and the DC setting should be above the point where this takes place. The tune line should be free of oscillation during normal operation.

6-73. Move the indicated tune line DC level high by adjusting R1311 (Integrator Centering). Control settings:

Frequency Select Switch.	.118.0 MHz
Counter Mode Switch.	FREQ

1. Adjust L1303 for an indicated frequency of 132.0 MHz.

2. Move the tune line level low by adjusting R1311.

3. Verify the oscillator to have an output frequency of 106.5 MHz or less.

4. Adjust R1311 to move the tune line level high.

5. Select a frequency of 140.0 MHz.

6. Adjust L1304 for an indicated frequency of 158.5 MHz.

7. Adjust R1311 for a low level tune line.

8. Verify the oscillator to have an indicated frequency of 128.5 MHz or less.

9. Adjust R1311 for a high level tune line.

10. Select a frequency of 338.0 MHz.

11. Adjust L1308 for an indicated frequency of 337.0 MHz .

12. Adjust R1311 for a low level tune line.

13. Verify the G/S oscillator to have an indicated frequency of 327.5 MHz or less.

14. Using the Flexible Coax cables (IFR P/N 1-16-0214) and the TEE connector as shown in Figure 6-32, monitor the phase lock tune line with the oscilloscope.

15. Adjust R1311 max CCW and note the DC level displayed on the oscilloscope.

16. Adjust R1311 max CW and note the DC level displayed on the oscilloscope.

17. Adjust R1311 to obtain a DC level approximately two-thirds the most positive value obtained in the preceeding steps.

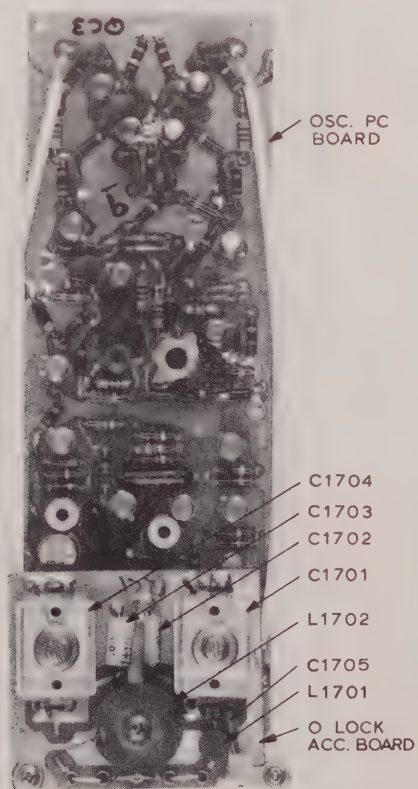
18. Verify Ø LOCK lamp ON.

6-74. RF Output Check.

1. Verify the RF output at J133 and J131 to be 0 dBm (± 3dB) throughout the frequency range of the oscillator.

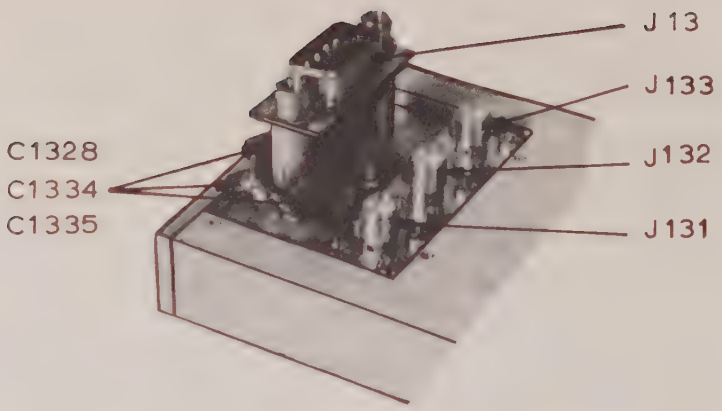
6-75. PLL Trap Frequency Adjustments.

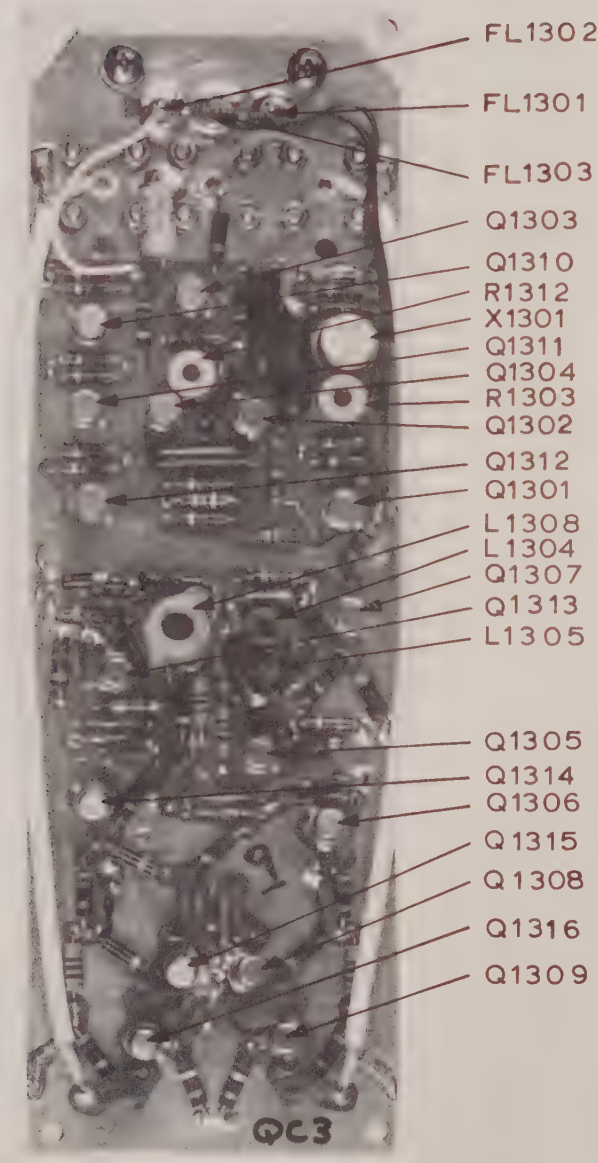
1. Adjust the null pot (R1181) max CCW.
2. Tune the Wave Analyzer to 25 kHz and adjust the oscillator's 25 kHz trap for a definite null on the Wave Analyzer.
3. Tune the Wave Analyzer to 12.5 kHz and adjust the oscillator's 12.5 kHz trap for a definite null on the Wave Analyzer. (46dB below 0.1V or less signal)
4. Remove the 12.5 kHz jumper.
5. Adjust the null pot (R1181) for a minimum level on the Wave Analyzer.
6. Reconnect the 12.5 kHz jumper.
7. Re-evaluate the system's performance using the procedures outlined in the Performance Evaluation Section.



TRAP BOARD ASSY. NAV-750

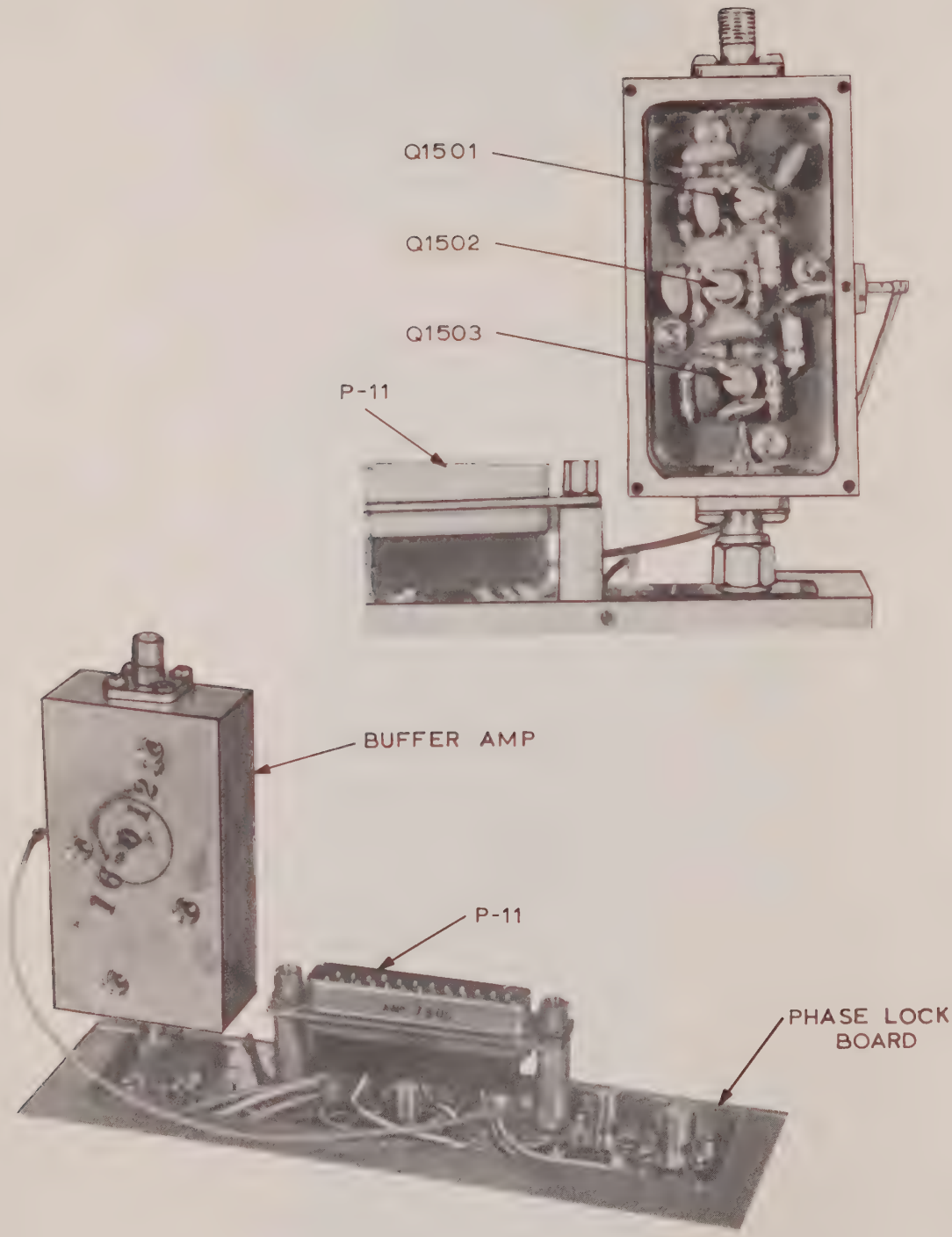
FIG. 6-17





OSCILLATOR ASSEMBLY
NAV-750

FIG. 6-18



PHASE LOCK ASSEMBLY & BUFFER AMPS
NAV-750

FIG. 6-19

Performance Check of RF Buffer Assemblies

(Both Single and Double)

6-76. Required Test Equipment and Fixtures.

RF Sweep Signal Generator. . Wavetek Model 2000 or similar

Spectrum Analyzer. . . . . HP 8554L RF Section, 8552 IF Section, 140T Display Section

6-77. Introduction.

There are no adjustments for these assemblies. A performance check of the individual units may be made in the following manner.

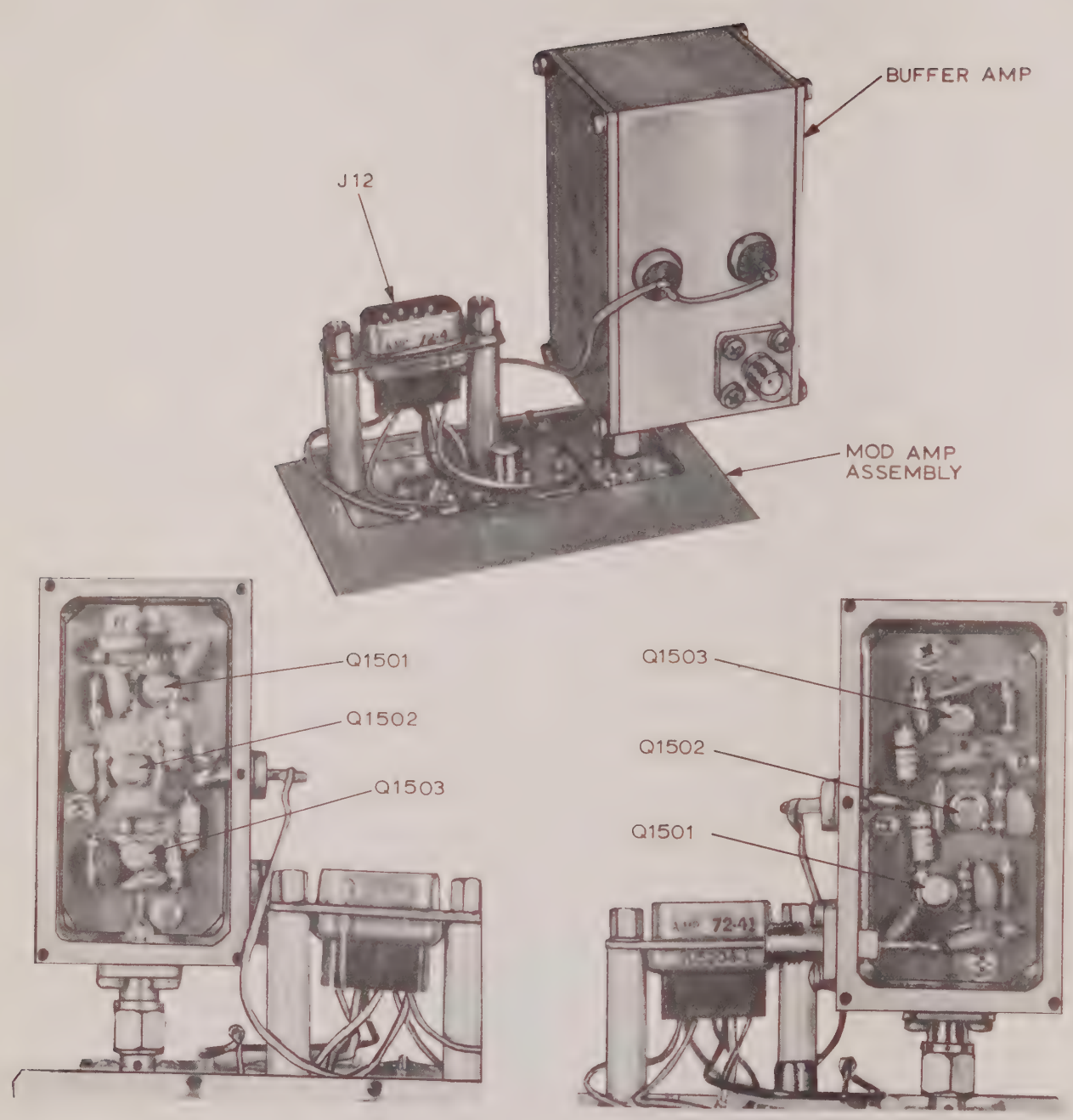
6-78. Initial Procedures:

Remove the Buffer Amplifier assemblies from the NAV-750 unit under test and apply +12V to the buffer as in normal operation.

6-79. Procedures:

1. Connect an RF Sweep Generator to the input and sweep the frequency range between 108.00 MHz and 337.00 MHz.

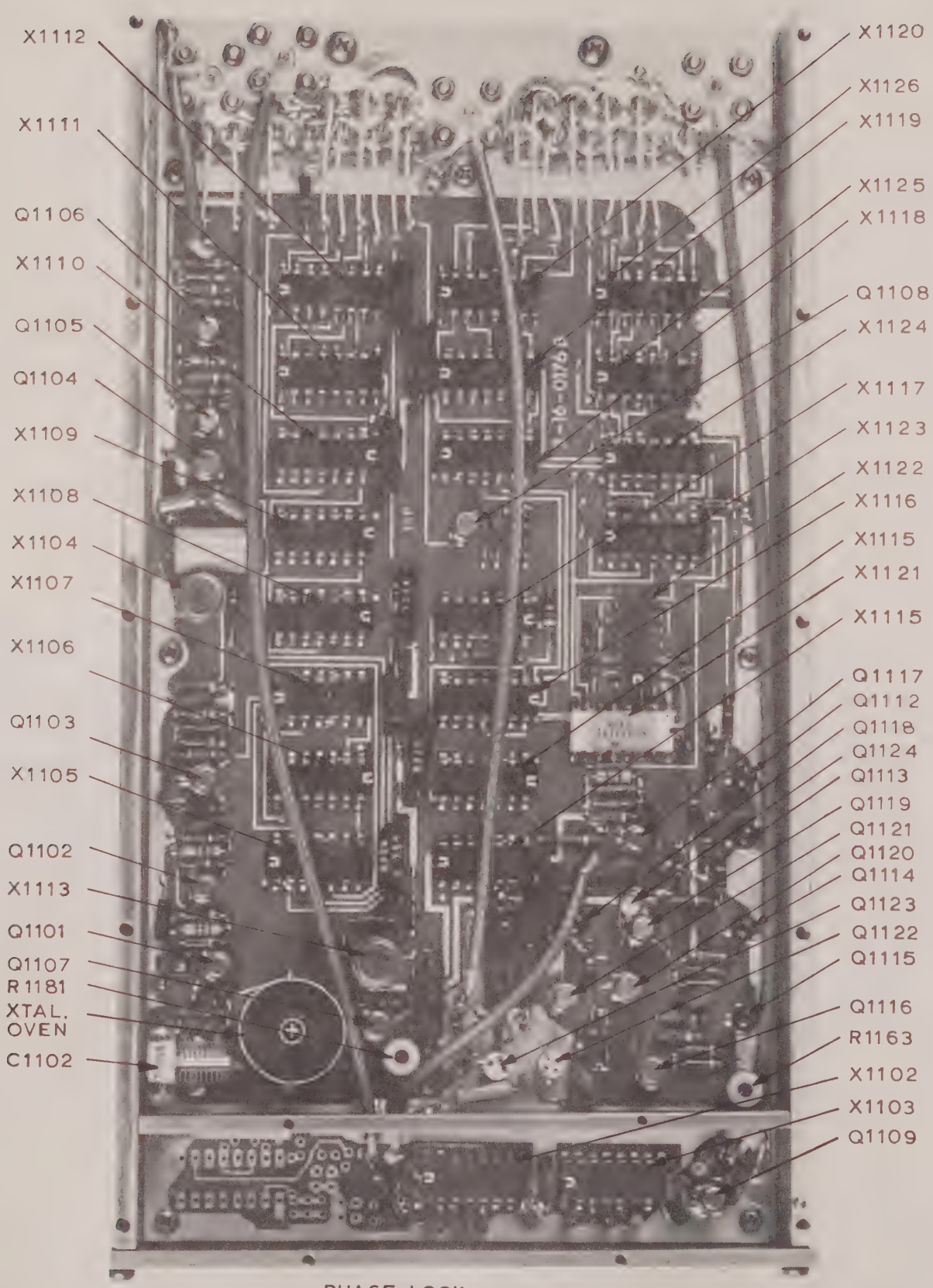
2. Connect the output of the Buffer Amp to the Spectrum Analyzer and verify the output to not go above -20.0 dBm or below -31.0 dBm with a measured RF input of -30.0 dBm.



MOD AMP ASSEMBLY & BUFFER AMP

NAV-750

FIG. 6-19.1



PHASE LOCK BOARD
NAV-750

FIG. 6-20

6-80. Required Test Equipment and Fixtures.

Digital Voltmeter. . .	Fluke 8000A or equivalent
VOM.	(20,000 ohms/volt minimum impedance)
Oscilloscope. . . .	Dual-Trace, minimum 40 MHz frequency response. (typically Dumont 1052)
RF Frequency Counter	120 MHz minimum frequency response, minimum sensitivity of -10 dBm time base accuracy of .00005%

6-81. Introduction.

As with other sections of the RF system, the Phase Lock board must be adjusted while connected for normal operation of the NAV-750.

6-82. Initial Procedures:

Adjust R1155 for +11.0V (±0.20) measured at the collector (case) of Q1107.

Perform the tests outlined in the Performance Evaluation Section.

6-83. 10 MHz Clock Adjustment: Control settings:

Frequency Select Switch.	110.0 MHz
△F Control.	CAL

1. Connect the RF frequency counter to the front panel RF output jack (J3) and adjust C1102 (Refer to Side Panel Drawing) for an indication of 110.00 MHz (± 100Hz).

6-84. Integrator Centering Adjust:

1. Refer to the Oscillator Adjustment Procedure and adjust the Integrator Centering as specified in the procedure.

2. Verify proper operation of the Phase Lock board using the procedures outlined in the Performance Evaluation Section.

Check and Adjustment Procedure
Modulator Amplifier

6-85. Required Test Equipment and Fixtures.

RF Power Meter. . . General Microwave 460B with 1mW power head or equivalent

Oscilloscope. . . . .Dual-Trace, minimum 40 MHz frequency response, (typically DUMONT 1052)

Digital Voltmeter. . .Fluke 8000A or equivalent

6-86. Introduction.

6-87. The Modulator Amplifier, one of the RF Assemblies of the NAV-750, is housed in a shielded box mounted to the floor of the NAV-750. The Modulator Amplifier receives its RF input at J112 from the Oscillator Assembly after the RF has passed through a separate buffer amplifier stage.

6-88. The Modulator Amplifier consists of several RF amplifier stages and the circuitry which modulates the RF signal. In the circuitry is the demodulator section which feeds the RF levelling circuitry and also has an output present at the rear panel jack J23.

6-89. Extremely important in the calibration of the NAV-750, the Modulator Amplifier is the point where the modulator and RF meet. The circuitry in this single assembly determines the level of the RF signal presented to the attenuator and then to the front panel jack (J3), and determines the ability of the RF signal to be modulated at the proper level. The input RF level to the Modulator Amplifier should be at least 0 dBm (±3.0dB), and the output should be 0 dBm (±1.0dB).

6-90. The Modulator Amplifier contains two separate, switch selected, strings of RF stages--one string for the low frequency band and one for the G/S frequency band. The actual switching is done in the Modulator Amplifier, but the signal which actuates the switch is generated by the operator through the function of the Frequency Control Board.

6-91. Initial Procedures:

Refer to figures 8-1 and 6-27 for proper connection of the Modulator Amplifier in the NAV-750 while testing and adjusting.

6-92. LOW Band RF Level Adjust: Control settings:

Frequency Select Switch. . . . . 132.00 MHz
All Tone Level Controls. . . . . .Cal
Counter Mode Switch. . . . . .Frequency

1. Connect the Oscilloscope to the DEMOD jack (J23).

2. Observe the demodulated output (1020Hz) and advance the MASTER MOD and the 1020 level controls until the scope waveform indicates clipping on the negative portion of the waveform with no evident clipping on the positive portion.

3. Verify the front panel OVERMOD lamp to be on when the waveform shows clipping.

4. Select 132.00 MHz and set MASTER MOD to UNCAL max CCW.

5. Observe the detected DC level at the detector, TP 3, to be between 5.0 and 5.6 volts and to not vary more than ±0.075 volts over the full frequency range of the generator.

6. Connect the RF power meter to J121 of the modulator amplifier (RF output), and adjust R1218 (RF level) for 0 dBm (± 0.2dB).

7. Select frequencies between 108.00 MHz and 157.95 MHz and verify the RF output level at J121 to be 0 dBm (± 1.0 dBm) throughout the frequency range of the generator.

6-93. G/S RF Level and Tuning Adjust: Control settings:

Frequency Select Switch. . . . . 332.00 MHz
All Tone Level Controls. . . . . .Cal
Counter Mode Switch. . . . . FREQ
G/S DDM 0

1. Connect the oscilloscope to J23 (DEMOD) and verify the demodulated signal to be the composite 90Hz and 150Hz waveform normally associated with G/S modulation.

2. Advance the MASTER MOD control until the waveform indicates clipping on the negative portion with no clipping evident on the positive portion of the waveform.

3. If positive clipping occures, adjust C1220, C1224, C1228, and C1223 for maximum envelope amplitude and minimum clipping on the positive portion of the waveform. Observe there are no parasitic oscillations or other irregularities.

4. Select a frequency of 334.70 MHz and adjust C1239 for maximum envelope amplitude and minimum clipping.

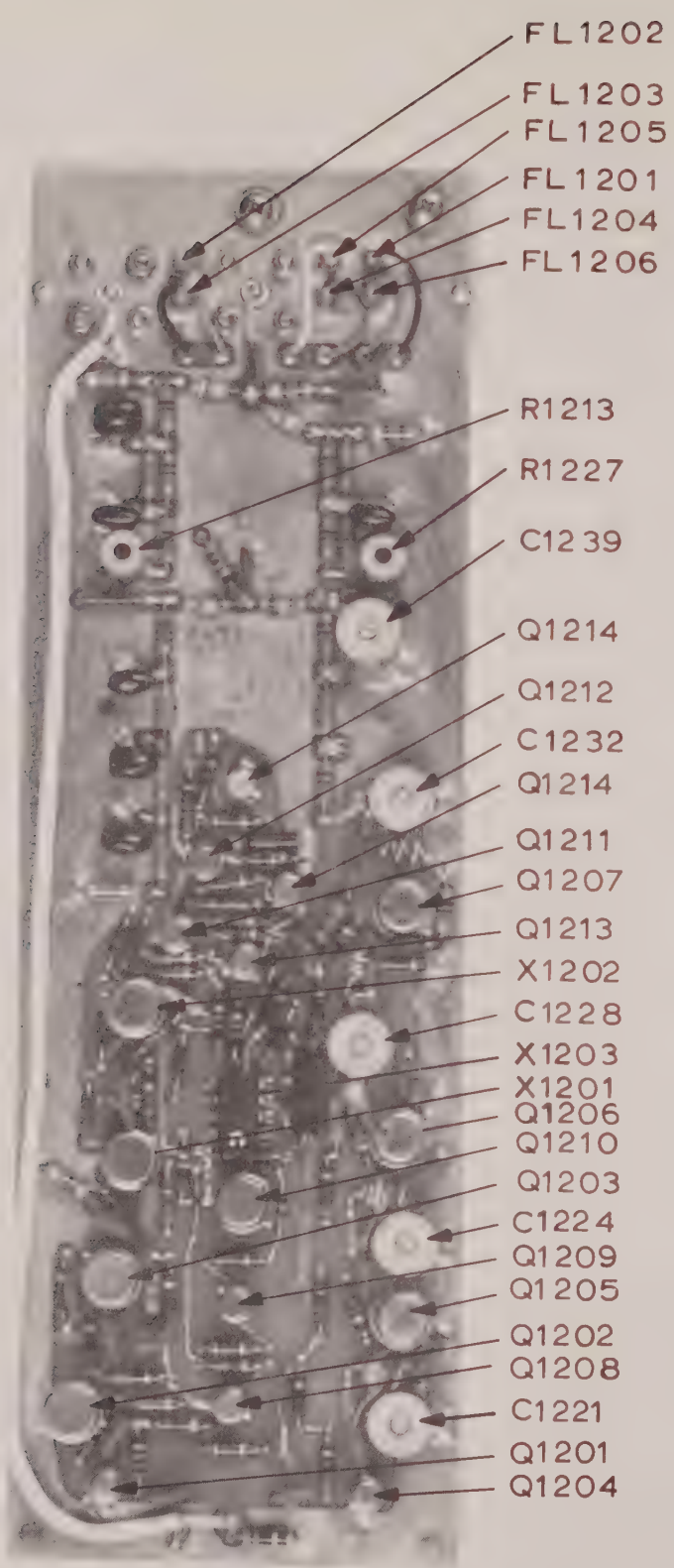
5. Remove modulation by setting the MASTER MOD control to UNCAL max CCW.

6. Connect the power meter to J121 (RF output) and adjust the RF level out to be 0 dBm (± 0.2 dBm) with the RF level adjust (R1227).

7. Verify the RF output at J121 to remain at 0 dBm (±1.0dB) throughout the G/S frequency range.

8. While observing the demodulated output, verify the set's ability to modulate to near 100% throughout the unit's G/S frequency range. (328.00 MHz to 338.00 MHz).

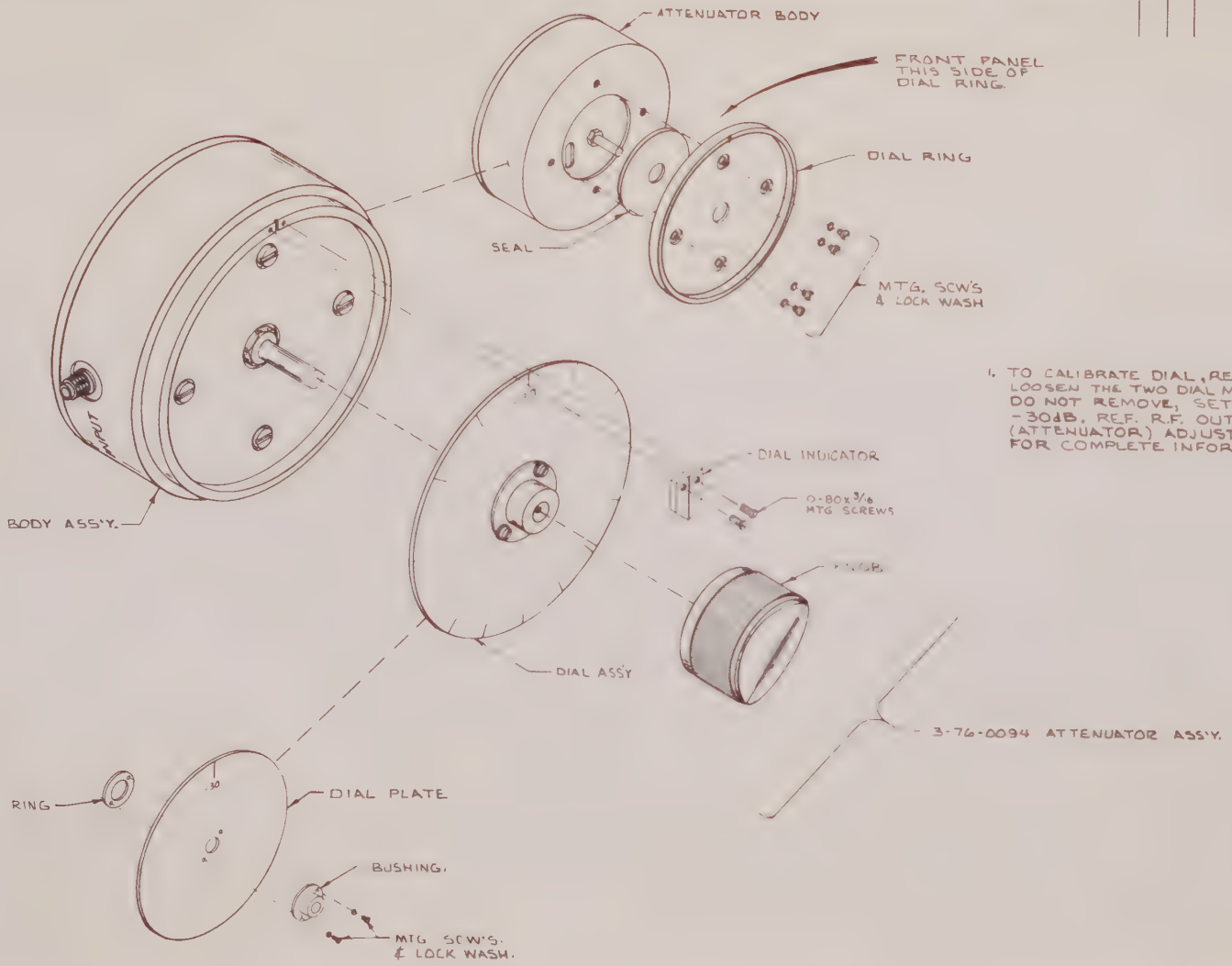
9. Repeat the procedures outlined in the Performance Evaluation Section and verify correct performance of the NAV-750 unit being tested.



MOD AMP ASSEMBLY
NAV-750

FIG. 6-21

DATE	REV	CHANGE	APP'D



1. TO CALIBRATE DIAL, REMOVE KNOB & LOOSEN THE TWO DIAL MTG SCREWS BUT DO NOT REMOVE, SET DIAL TO -30dB. REF. R.F. OUTPUT LEVEL (ATTENUATOR) ADJUST PROCEDURE FOR COMPLETE INFORMATION

FIG 6-22

NEXT ASSY	QTY	MODEL	ITEM	REQ'D	PART NO	DESCRIPTION
	1	NAV 760	1	1	3-76-0225	ATTENUATOR

APPLICATION — LIST OF MATERIALS

TOLERANCES

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA KANSAS

TITLE: ATTENUATOR ASS'Y.

SIZE — PART NUMBER — REV

SCALE — WEIGHT — SHEET 1 OF 1

RF Output Level (ATTENUATOR) Check and Adjustment

6-94. Required Test Equipment and Fixtures.

RF Power Meter. . . . . .General Microwave 460B with 1mW power head or equivalent

6-95. Introduction.

This procedure is performed at the factory and usually need not be utilized in the field except in the event of an attenuator assembly replacement. Before attempting the adjustment procedure, an actual maladjustment or malfunction should be determined using the procedure outlined in the Performance Evaluation Section.

6-96. Initial Procedure:

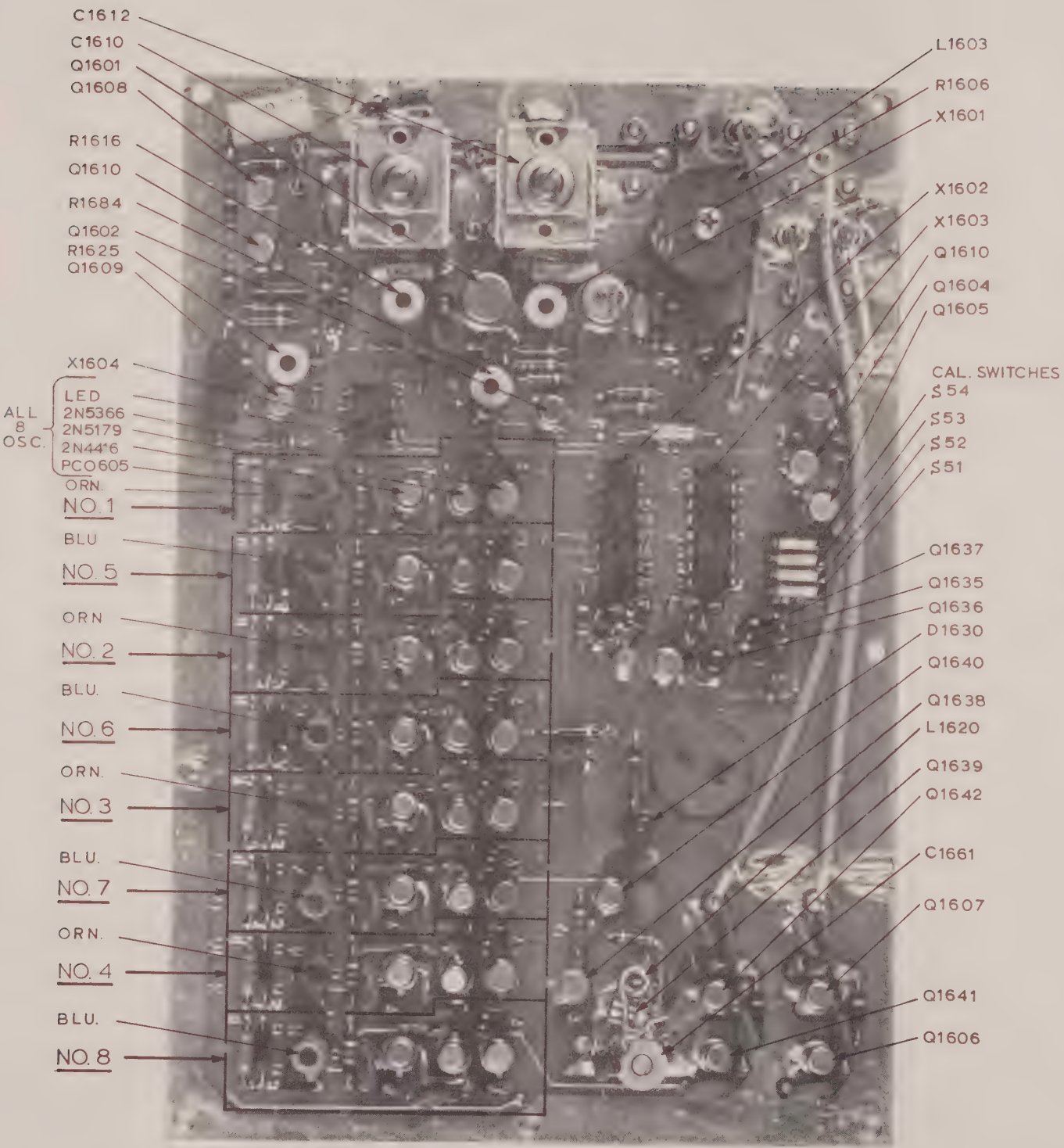
Perform those checks outlined in Performance Evaluation Section.

6-97. Adjustment Procedure: Control settings:

Frequency Select Switch. . . . . 138.00 MHz

MASTER MOD. . . . . Uncal Max CCW

1. Refer to figure 6-24. Remove the knob on the attenuator assembly, and loosen but DO NOT REMOVE the two dial mounting screws.
2. Rotate the attenuator dial CW for an indication on the Power Meter of exactly -30 dBm.
3. Position the dial for agreement with the Power Meter at the -30 dBm position.
4. Tighten the two mounting screws earlier loosened.
5. Verify proper performance of the attenuator assembly using the procedure outlined in the Performance Evaluation Section.



EIGHT STEP OSCILLATOR
NAV-750

FIG. 6-23

Test and Alignment Procedure for 8-Step Oscillator

6-98. Required Test Equipment and Fixtures.

20 MHz Dual Trace Oscilloscope
Digital Voltmeter
Flexible Test Cable. . . . . .IFR P/N 1-16-0214 (five required)
Coaxial TEE Connector. . Americon P/N 2091-0000
BNC Adaptor. . . . . Americon P/N 2081-2321

6-99. General:

6-100. This procedure is primarily a guide for test and re-alignment of the 8-Step Oscillator after improper operation has been noted or after a malfunction affecting performance has been corrected. However, if the performance of the unit is in question, this section will serve as a invaluable guide in determination of trouble location.

6-101. ——————NOTE——————

The adjustments outlined in the procedure are set at the factory and should not require re-alignment during normal operation of the set. Do not reset any adjustment before determination of an actual maladjustment or malfunction.

6-102. Preliminary Set-Up:

Remove 8-Step Oscillator from set and remove bottom cover of oscillator to allow access to adjustments. Connect all assemblies and test equipment as shown in Figure 6-28.

6-103. 11V Regulator Adjust:

1. Adjust R1606 (11V adjust) for 11V (±0.1V) at collector (case) of Q1601.

2. Disconnect the phase lock tune line at J132.

3. Verify the subregulated 5.5V supply to be 5.5V (4.8-6.2V) at the emitter of Q1611.

6-104. Individual Oscillator Frequency Adjust: (Read all frequencies on the NAV-750's frequency counter.)

1. Using the table below, manually select each oscillator, and verify that it's associated LED is on.

2. For each oscillator, adjust the indicated tuning coil for the frequency listed (±0.1 MHz).

3. Move the tuning integrator to it's high limit by:

   Adjusting R1626 (Integrator centering adjust) in the direction which causes the frequency counter reads a frequency at the high end of the oscillator band - or

   Setting the front panel Frequency Select switch to a frequency higher than the indicated high end frequency of that oscillator.

6-105. ———— NOTE ————

Do not use a digit higher than 7 in the X10 position of the Frequency Select switch.

TABLE (8-A)

Osc	CAL SW S1	S2	S3	S4	Coil/ Cap	Freq-MHz
1	ON	ON	ON	ON	L1605	115.3
2	OFF	ON	ON	ON	L1607	120.8
3	ON	OFF	ON	ON	L1609	126.6
4	OFF	OFF	ON	ON	L1611	132.7
5	ON	ON	OFF	ON	L1619	139.1
6	OFF	ON	OFF	ON	L1617	145.7
7	ON	OFF	OFF	ON	L1615	152.8
8	OFF	OFF	OFF	ON	L1613	160.0
*9	ON	ON	ON	ON	C1661	337.0
Auto Select	ON	ON	ON	OFF	-	-

*Also select any 300 MHz frequency on FREQUENCY thumbwheel.

6-106. Oscillator Low Range Check and Adjustment.

1. Connect a 50K ohm potentiometer between the collector or Q1608 and the collector of Q1610.

2. Adjust the potentiometer for 2.7V (±0.05V) measured at the collector of Q1610.

3. Refer again to Table 8-A, select each oscillator, and verify the low frequency of each oscillator to be within the range specified below.

#1____(103.0-106.0 MHz)	#5_____(125.7-128.7 MHz)
#2____(108.3-111.3 MHz)	#6_____(132.1-135.1 MHz)
#3____(113.8-116.8 MHz)	#7_____(138.7-141.7 MHz)
#4____(119.6-122.6 MHz)	#8_____(145.8-148.8 MHz)

6-107. Oscillator Switching Point Adjust.

1. Monitor pin #1 of X1604 with an oscilloscope, and adjust R1684 (Low Operation Limit) to the point at which the voltage at pin #1 begins to switch.

2. Adjust 50K pot and observe that the voltage at the collector of Q1610 is 2.7V as the voltage at pin #1 of X1604 reaches its high limit.

3. Adjust the "Tune Low Limit" (R1616) to obtain a voltage of 3.1V (±0.05V) at the anode of D1602.

4. Remove the 50K ohm pot used in step #1.

5. Move the tuning integrator to its high limit, select the G/S (#9) oscillator (refer to Table 8-A), and adjust the frequency of the G/S oscillator as specified in Table 8-A.

6. Reconnect the 50K ohm pot as in step #1.

7. Adjust 50K pot to obtain 2.7V at the collector of Q1610, and observe the displayed frequency to be 327.00 MHz (320.0-327.2 MHz).

6-108. RF Output Check.

1. Verify the RF output at J133 to 0 dBm (±3 dBm) while the oscillator frequency is 337.0 MHz.

2. Verify the RF output at J131 to be 0 dBm (±3 dBm) at the oscillator frequency of 337.0 MHz.

3. Select an oscillator frequency of 115.3 MHz and verify the RF outputs at J133 and J131 to be as stated in steps 1 and 2.

6-109. Integrator Centering Adjust. (Refer to Fig 6-28)

1. Using the Flexible Coax cables (IFR P/N 1-16-0214) and the TEE connector as shown in Fig ~~6-4~~ 6-28, monitor the phase lock tune line with the oscilloscope.

2. Using Table 8-A, select a single oscillator.

3. Adjust R1626 to a max CCW position. Note the DC level on the oscilloscope.

4. Adjust R1626 to a max CW position. Note the DC level on the oscilloscope.

5. Adjust R1626 (Integrator Centering Adjust) to obtain a DC level centered between those levels noted in steps 3 and 4.

6-110.

———— NOTE ————

Exact centering in some units causes excessive residual FM. Verify this is not the case as per Performance Evaluation Section. (Step 5-50) Slight adjustment of R1626 may be necessary to relieve this problem.

6. Verify that the difference in levels noted in steps 3 and 4 is a minimum of 3V.

7. Using Table 8-A, position switches for normal automatic stepping operation.

8. Verify proper performance of the unit using the procedures outlined in the Performance Evaluation Section.

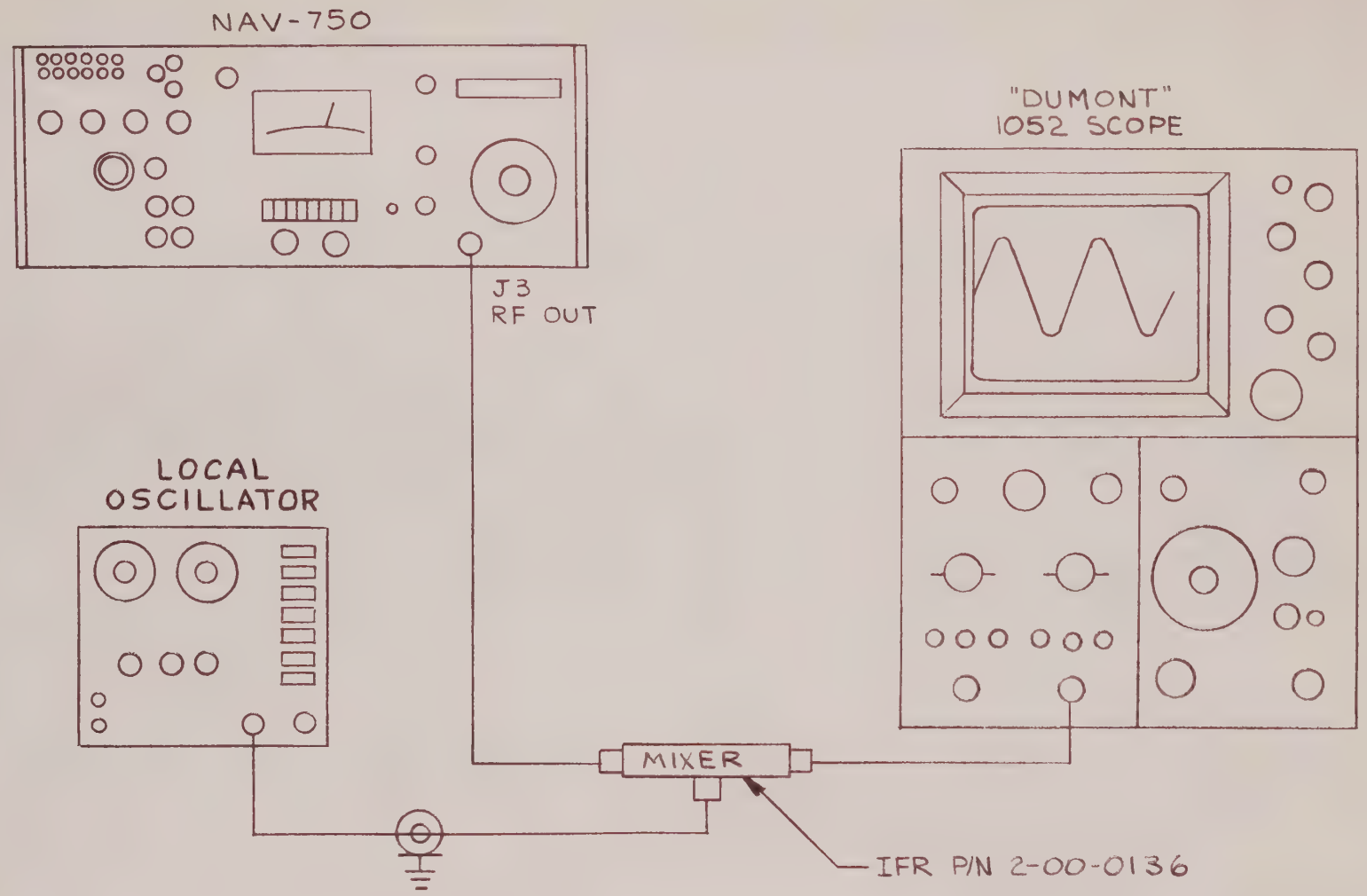

NAV-750
J3
RF OUT
"DUMONT"
1052 SCOPE
LOCAL
OSCILLATOR
MIXER
IFR P/N 2-00-0136

FIG. 6-25

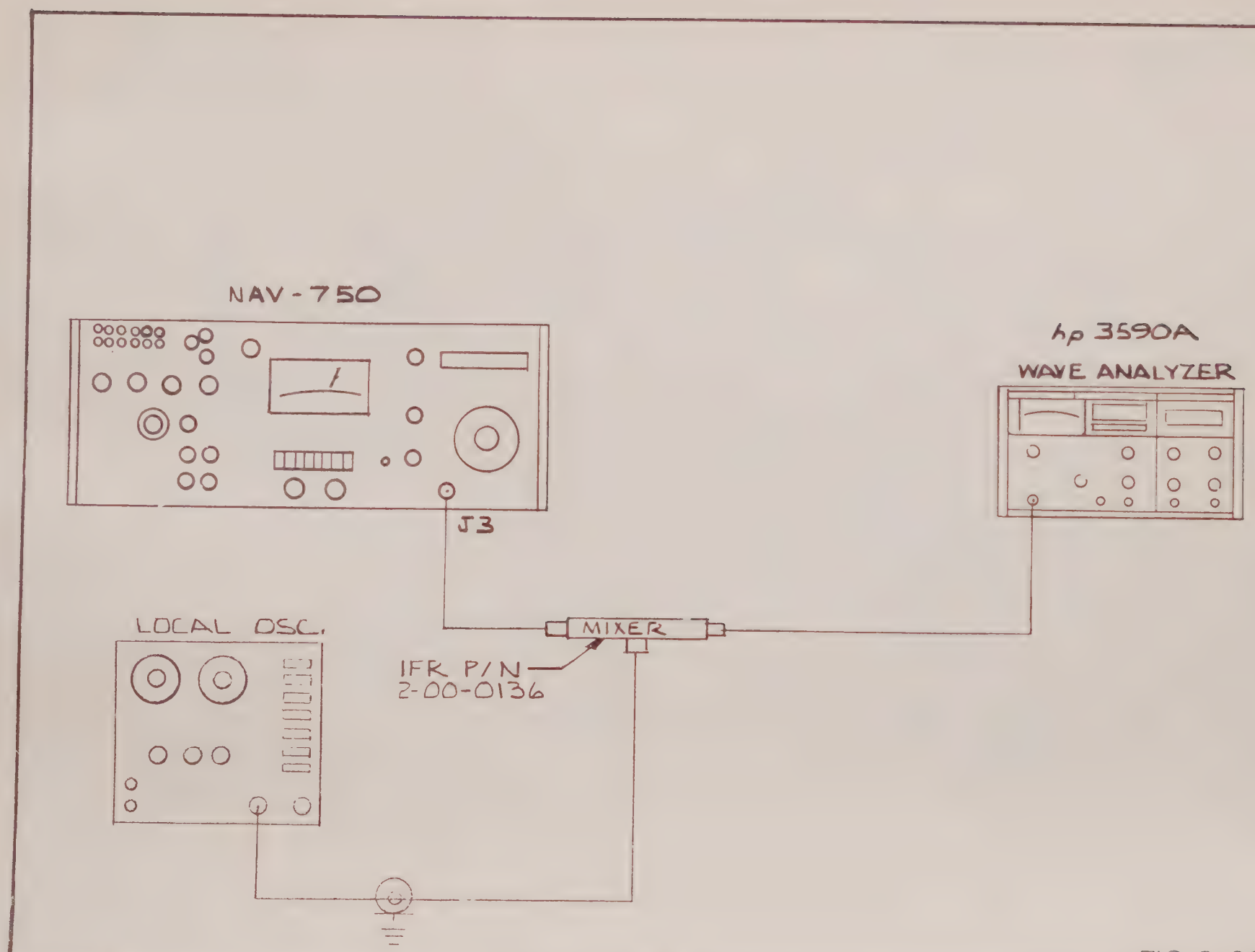

NAV-750
J3
hp 3590A
WAVE ANALYZER
LOCAL OSC.
MIXER
IFR P/N
2-00-0136

FIG. 6-26

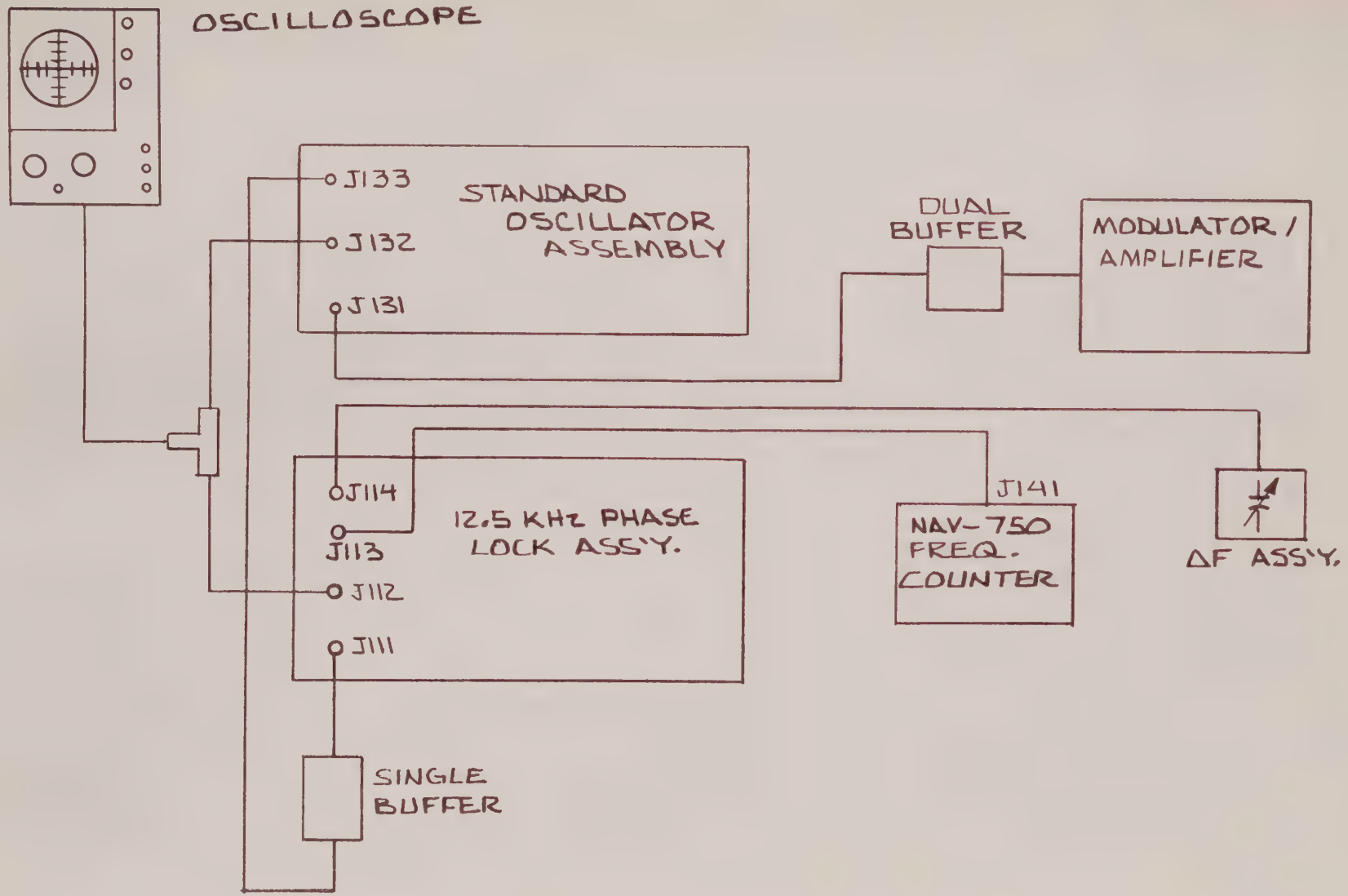

OSCILLOSCOPE
J133
J132
J131
STANDARD OSCILLATOR ASSEMBLY
DUAL BUFFER
MODULATOR / AMPLIFIER
J114
J113
J112
J111
12.5 KHz PHASE LOCK ASS'Y.
J141
NAV-750 FREQ. COUNTER
ΔF ASS'Y.
SINGLE BUFFER

FIG. 6-27

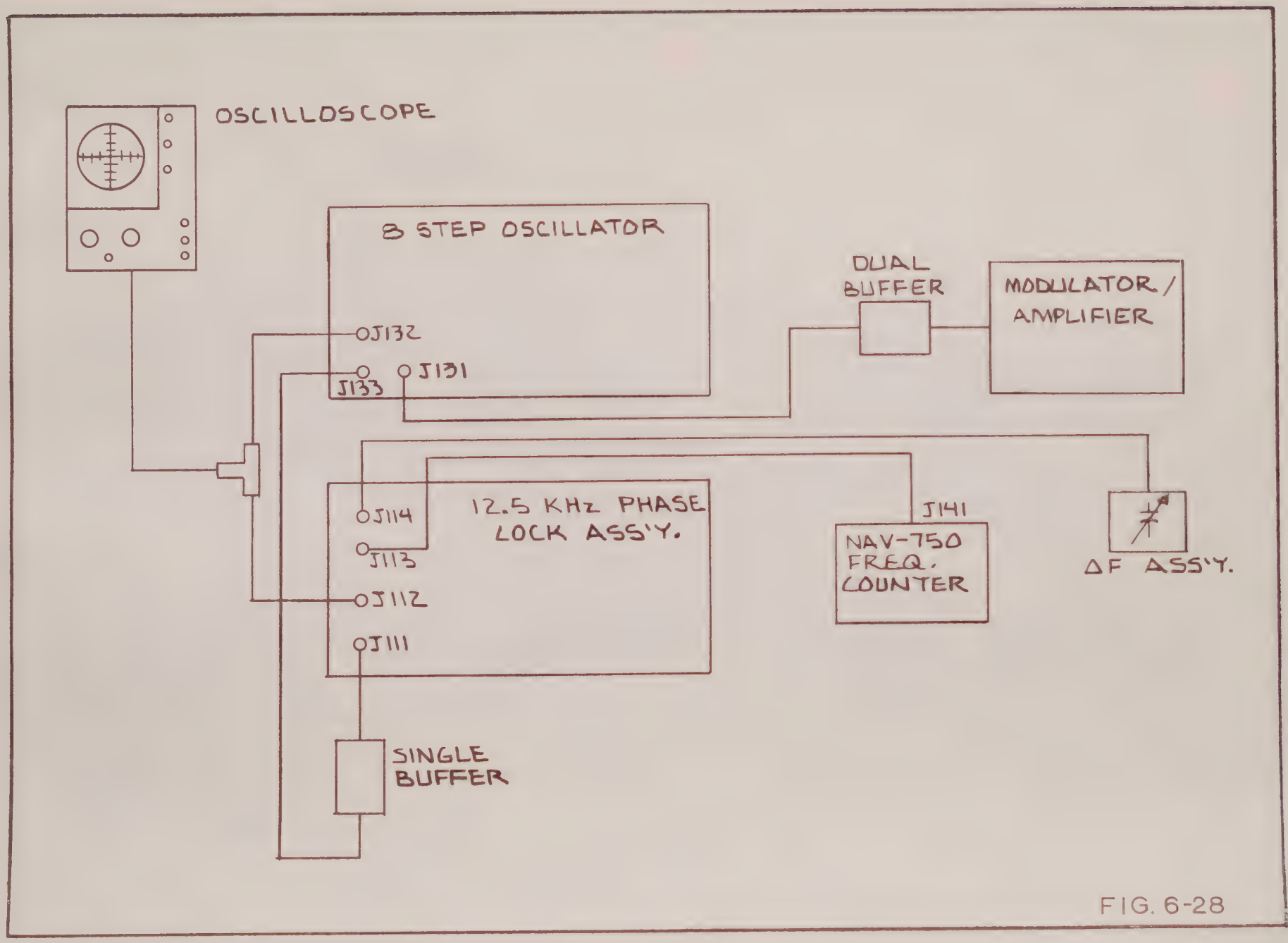

OSCILLOSCOPE
8 STEP OSCILLATOR
DUAL BUFFER
MODULATOR / AMPLIFIER
J132
J133
J131
J114
J113
J112
J111
12.5 KHz PHASE LOCK ASS'Y.
J141
NAV-750 FREQ. COUNTER
ΔF ASS'Y.
SINGLE BUFFER

FIG. 6-28

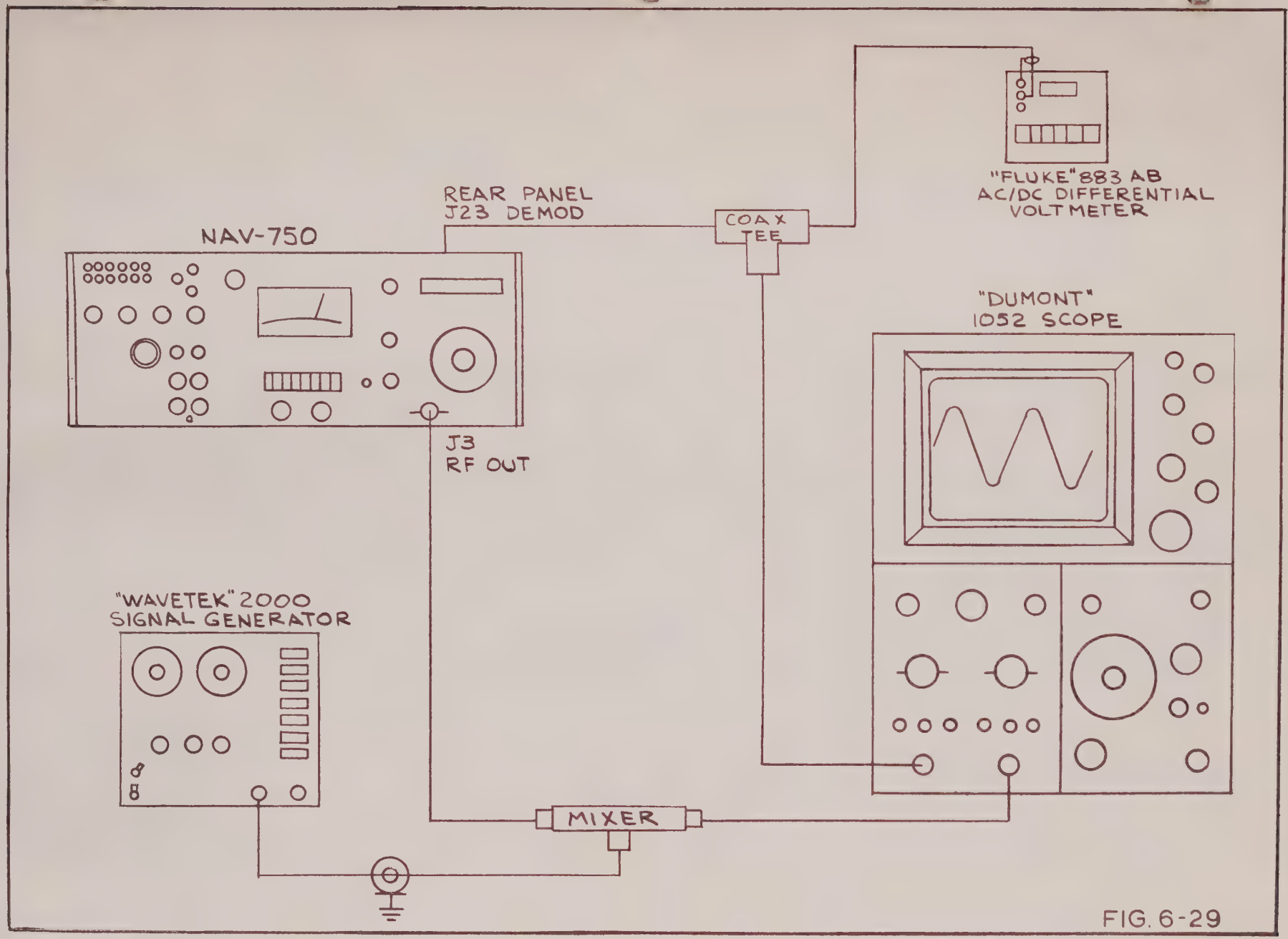

"FLUKE" 883 AB
AC/DC DIFFERENTIAL
VOLTMETER
REAR PANEL
J23 DEMOD
COAX
TEE
NAV-750
"DUMONT"
1052 SCOPE
J3
RF OUT
"WAVETEK" 2000
SIGNAL GENERATOR
MIXER

FIG. 6-29

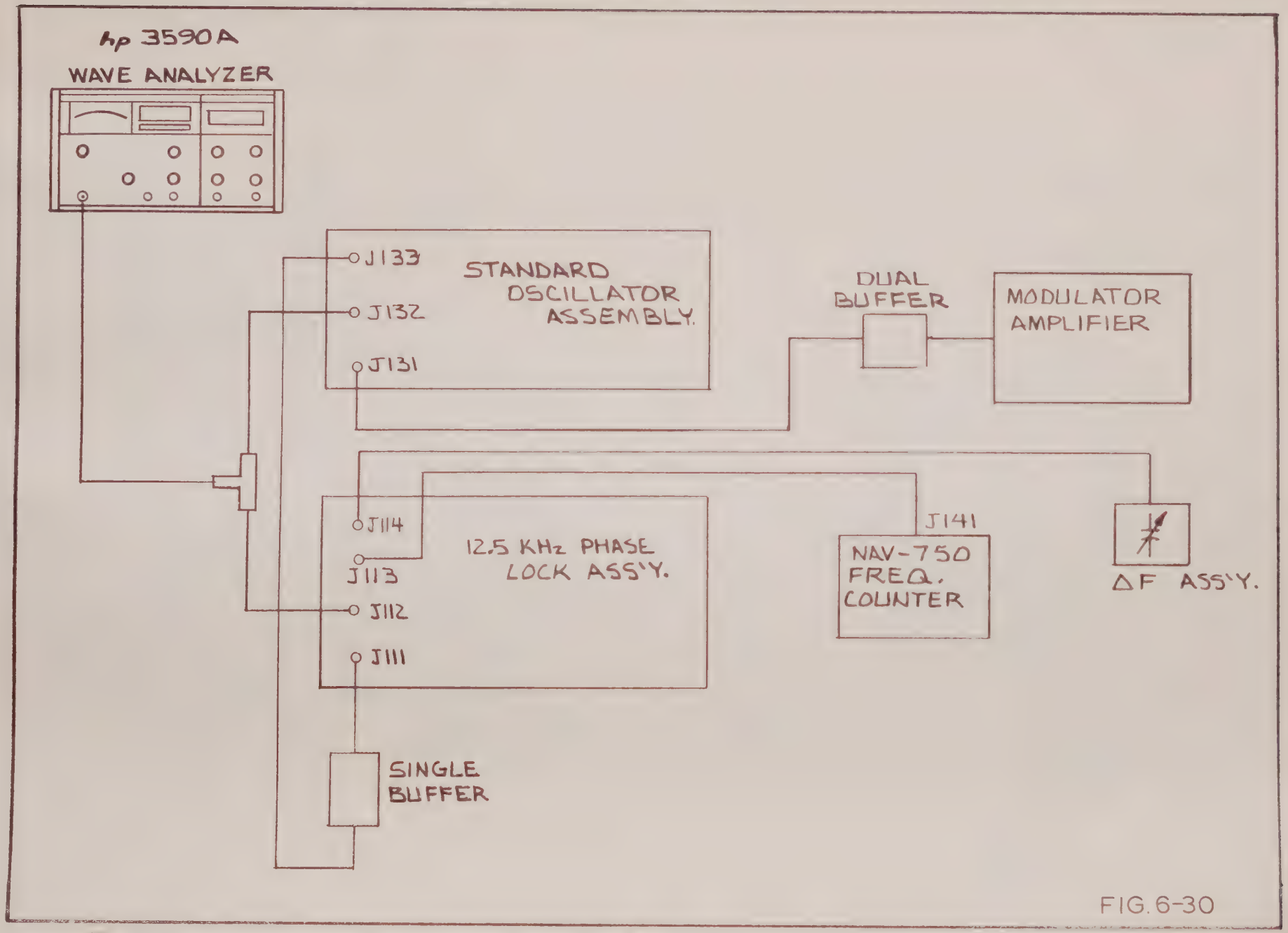

hp 3590A
WAVE ANALYZER
J133
J132
J131
STANDARD
OSCILLATOR
ASSEMBLY.
DUAL
BUFFER
MODULATOR
AMPLIFIER
J114
J113
J112
J111
12.5 KHz PHASE
LOCK ASS'Y.
J141
NAV-750
FREQ.
COUNTER
ΔF ASS'Y.
SINGLE
BUFFER

FIG. 6-30

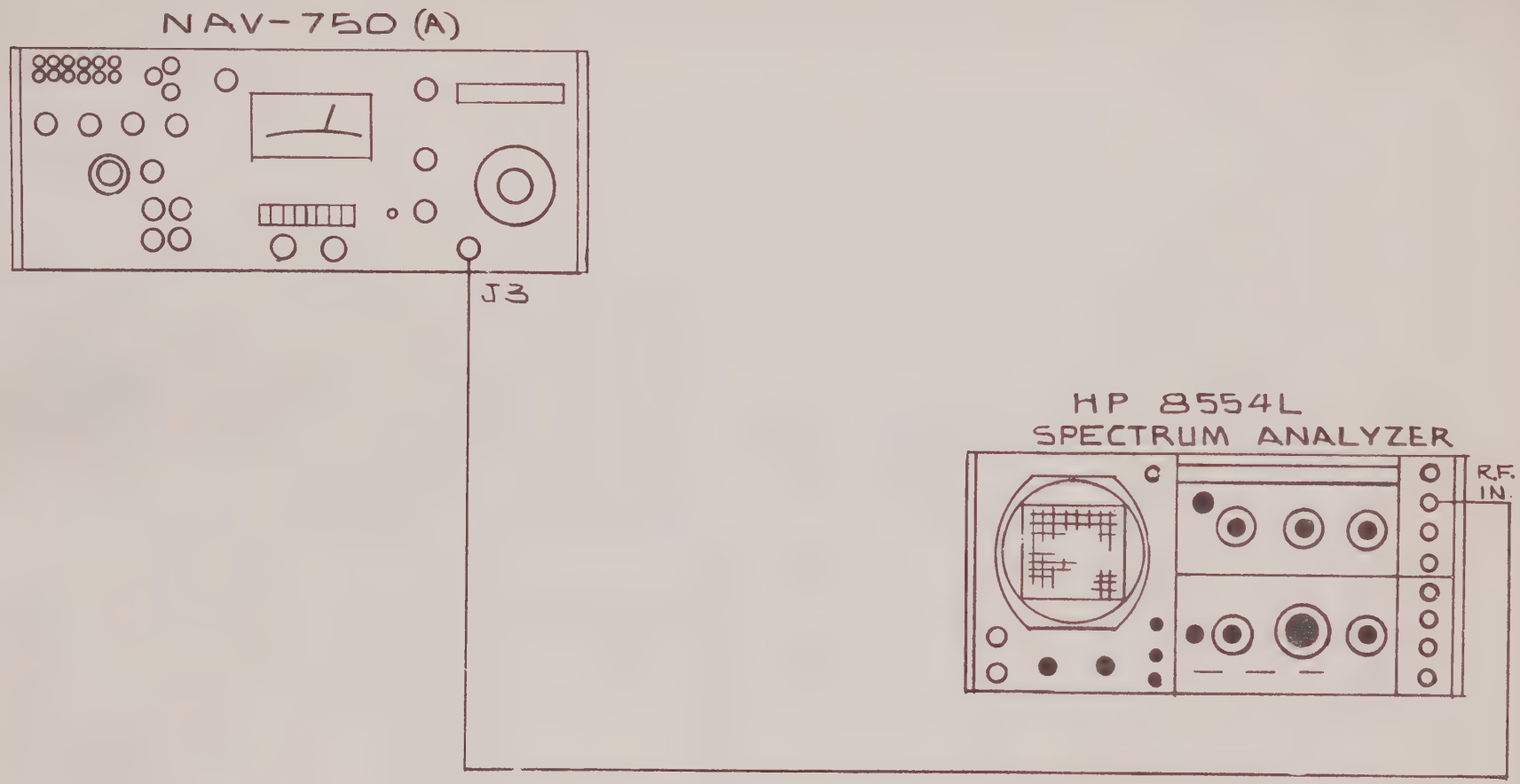


FIG. 6-31

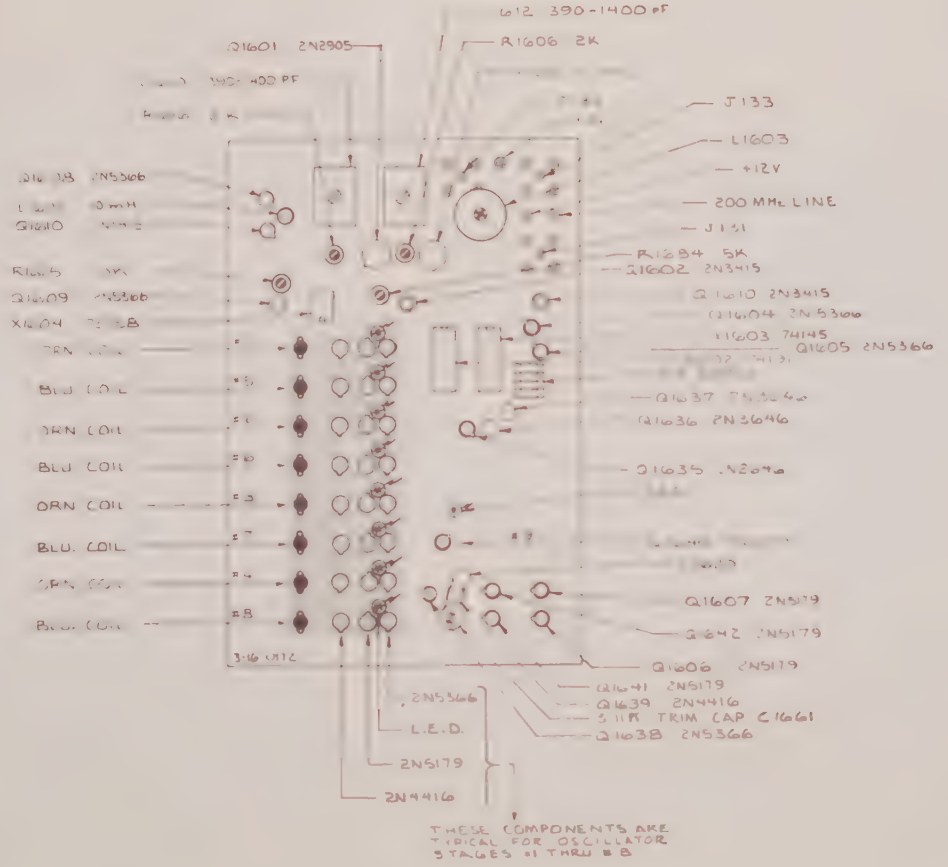


FIG. 6-32

QTY	MODEL	ITEM	REQ'D	PART NO	DESCRIPTION
1		1	1		8 STEP OSC (PARTS LAYOUT)

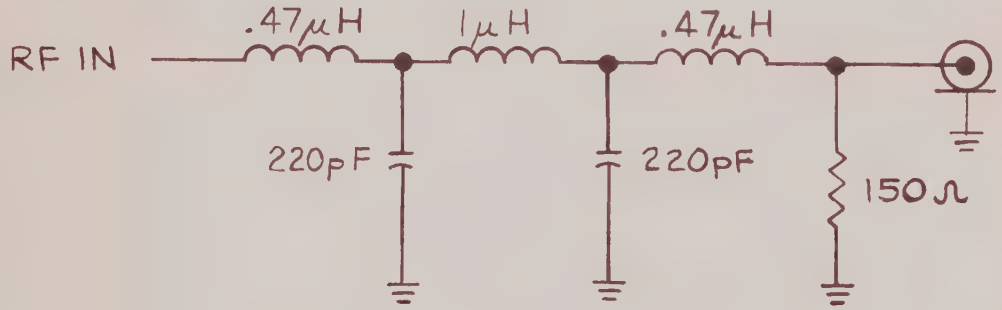
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA KANSAS

8 STEP OSC.
(PARTS LAYOUT)

SIZE A | PART NUMBER 516-017CA | REV

SHEET 2 of 2

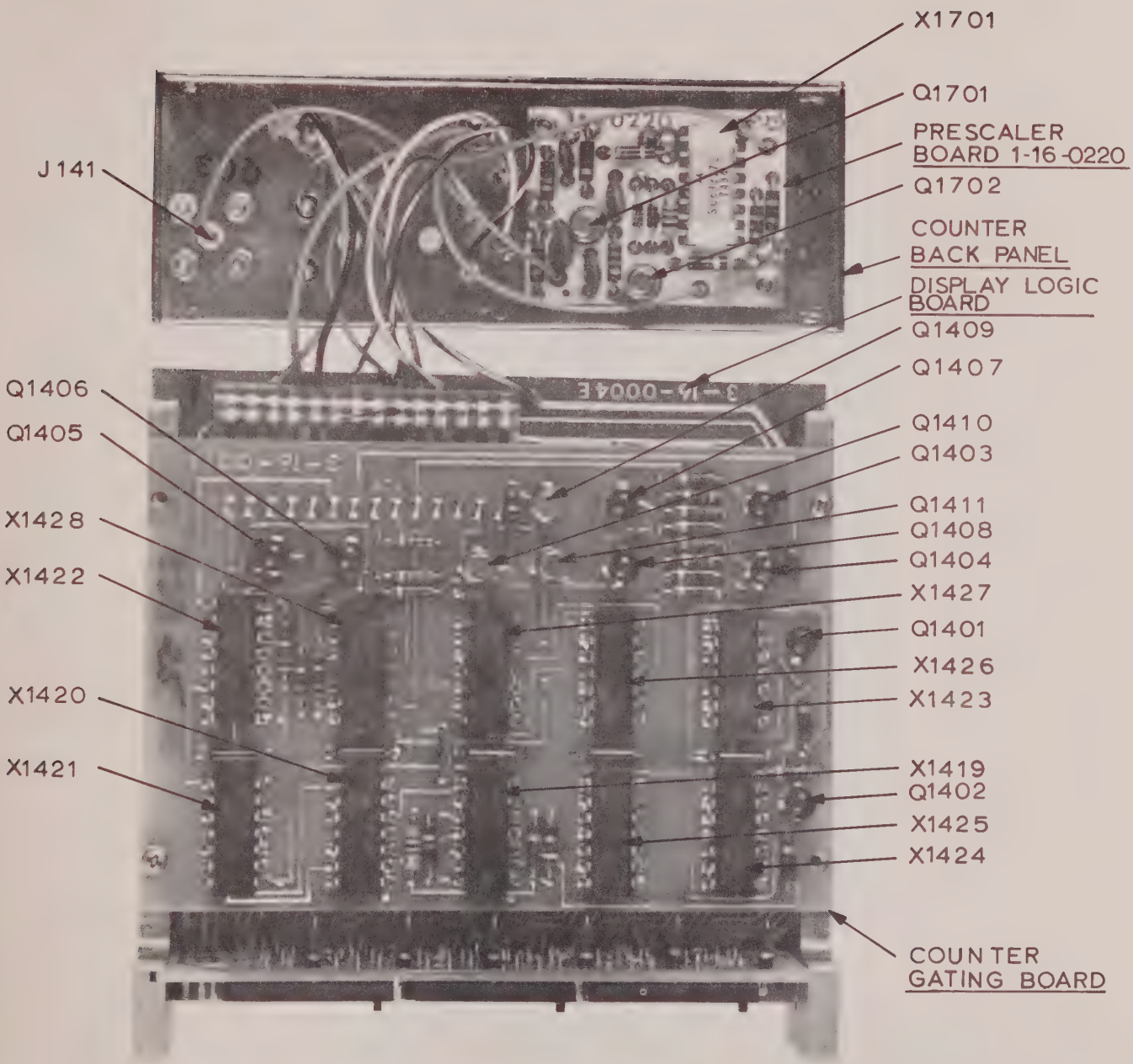
LOW-PASS FILTER
25 MHz CUT OFF FREQUENCY
(FOR USE WITH RF MIXER)



NOMINAL 50Ω INPUT AND OUTPUT IMPEDANCE.

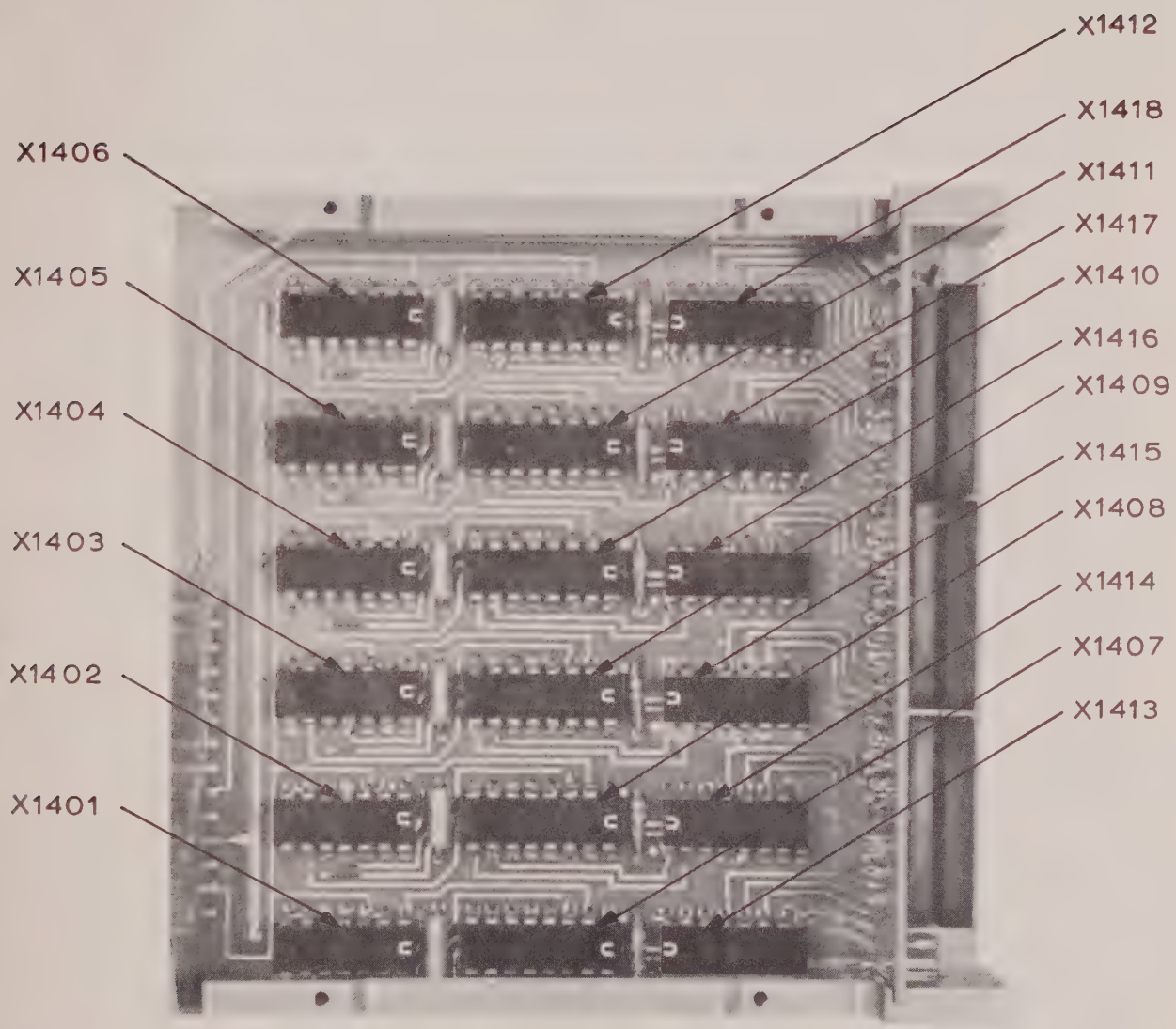
LOW PASS FILTER USED WITH RF MIXER (TYPICALLY ANZAC MD-113) FOR MODULATION PERCENTAGE MEASUREMENTS AND RESIDUAL FM MEASUREMENTS.

FIG. 6-33



COUNTER GATING BOARD & PRESCALER BOARD

FIG. 6-34



COUNTER ASSEMBLY
DISPLAY LOGIC BOARD
NAV-750

FIG. 6-35

SECTION VII

Semiconductor and IC Guide

7-1. Introduction.

7-2. The NAV-750 Test Set utilizes a wide range of semiconductors and IC devices to accomplish it's purpose. Although all solid-state components have been in general use for many years now, it is still manufacturer's experience that improperly done repair of printed circuit boards and use of test devices not suited to transistors cause far too many failures that can be easily avoided. The intent of this section is to familiarize the repairing technician with approved methods of living with the modern technology.

7-3. This section is divided into two general areas - the repair of solid-state equipment in a manner that will prolong the equipment life, and a familiarization with the various IC's used and how to determine their proper operation.

7-4. Semiconductor Test Equipment. Damage to semiconductors by test equipment is usually the result of accidentally applying too much current or voltage to the elements. Common causes of damage from test equipment are discussed in the following paragraph.

7-5. Transformerless Power Supplies. Test equipment with transformerless power supplies is one source of high current. However, this type of test equipment can be used by employing an isolation transformer in the AC power line.

7-6. Line Filter. It is still possible to damage semiconductors from line current, even though the test equipment has a power transformer in the power supply, if the test equipment is provided with a line filter. This filter may function as a voltage divider and apply half voltage to the semiconductor. To eliminate this condition, connect a ground wire from the chassis of the test equipment to the chassis of the equipment under test befor making any other connections.

7-7. Low-Sensitivity Multimeters. Another cause of semiconductor damage is a multimeter that requires excessive current to provide adequate indications. Multimeters with sensitivities of less than 20,00-ohms-per-volt should not be used on semi conductors. A multimeter with low sensitivity will draw too much current through may types of small semiconductors

causing damage. When in doubt as to the amount of current supplied by a multimeter, check the multimeter circuits on all scales with an external, low-resistance multimeter connected in series with the multimeter leads. If more than one millampere is drawn on any range, this range cannot be safely used on small semiconductors.

7-8. Power Supply When using a battery-type power supply, always use fresh batteries of the proper value. Make certain that the polarity of the power supply is correct for the equipment under test. Do not use power supplies having poor voltage regulation.

Due to the wide utilization of semiconductors in this electronic equipment, somewhat different techniques are necessary in maintenance procedures. In sold-state circuits the impedances and resistances encountered are of much lower values than those encountered in vacuum-tube circuits. Therefore, a few ohms discrepancy can greatly affect the performance of the equipment. Also, coupling and filter capacitors are of larger values and usually are of the tantalum type. Hence, when measuring values of capacitors, an instrument accurate in the high ranges must be employed. Capacitor polarity must be observed when measuring resistance. Usually more accurate measurements can be obatined if the semi-conductors are removed or disconnected from the circuit.

7-9. Replacing Semiconductors.

7-10. (1) Transistors. Never remove or replace a transistor with the supply voltage turned on. Transients thus produced may damage the transistor or other components remaining in the circuit. If a transistor is to be evaluated in an external test circuit, be sure that no more voltage is applied to it than normally is used in the circuit from which it came.

7-11. (a) Use only a low heat soldering iron when installing or removing soldered in parts.

7-12. (b) When installing or removing a soldered in semiconductor grasp the lead to which heat is applied between the solder joint and the semiconductor with long nose pliers. This will dissipate some of the heat that would otherwise conduct into the semiconductor from the soldering iron. Make certain that all wires soldered to semiconductor terminals have fi r st been properly tinned so that the necessary connections can be made quickly. Excessive heat will permanently damage a semiconductor.

7-13. (c) In some cases, power transistors are mounted on heatsinks that are designed to dissipate heat away from them. In some power circuits, the transistor must also be insulated from ground. Often, this insulating is accomplished by means of insulating washers made of mica. When replacing transistors mounted in this manner, be sure that the insulating washers are replaced in proper order. After the transistor is mounted, and before making any connections check from the case of the transistor to ground with a multimeter to see that the insulation is effective.

7-14. (2) Integrated Circuits. If an IC is known to be defective, the best way to remove it is to cut off each of its pins, remove the case, and then unsolder the remaining pins from the integrated circuit card one by one. This is preferable over removing the IC intact because attempts to remove the IC intact may result in damage to the card. Note the marking identification of the IC before removal, and replace the new one with the same orientation as the one removed.

7-15. Following is a list of the IC's, their circuit functions, and board locations.

SN7400 (Quad 2-input NAND gate)	Tone Summation Board Bearing Logic Board Localizer/Bearing Control Frequency Control Phase Lock Circuit Digital Readout
SN7402 (Quad 2-input NOR gate)	Localizer/Bearing Control Frequency Control Phase Lock Control
SN7404 (Hex Inverter)	Localizer/Bearing Control Bearing Logic Board Frequency Control Remote Channeling Phase Lock Circuit
SN7405 (Hex Inverter with open Collector output)	Frequency Control
SN7409 (Quad 2-input and Gate with open Collector output)	Phase Lock Circuit

SN7410 (Triple 3-input NAND gate)	Tone Summation Board Bearing Logic Board
SN7420 (Dual 4-input NAND gate)	30Hz Sine Board Bearing Logic Board Localizer/Bearing Control Frequency Control Remote Channeling
SN7430 (Single 8-input NAND gate)	Bearing Logic Board Localizer/Bearing Control Frequency Control Phase Lock Circuit
SN7442 (BCD-to decimal decoder)	Frequency Control Remote Channeling
SN7473 (Dual J-K Flip-flop)	Frequency Control Phase Lock Circuit Bearing Logic
SN7475 (Quadruple Bistable latch)	Digital Readout
SN7476 (Dual J-K Master-slave flip-flop with preset and clear)	Frequency Control
SN7490 (Divide by 2,5, or 10)	Frequency Control Phase Lock Circuit Digital Readout
SN7492 (Divide by 12, 2 and 6)	Bearing Logic
SN7493 (4-bit Binary Counter)	30Hz Sine Board
SN74121N (Monastable Multi-vibrator)	Frequency Control Phase Lock Circuit

SN74123 (Dual Retriggerable Monostable Multi-vibrators)	Localizer/Bearing Control Bearing Logic Board
SN74190 (Sychronous Up/Down Decade Counters)	Frequency Control Bearing Logic
SN74191 (Sychronous Up/Down 4-bit Binary Counter)	Bearing Logic Frequency Control Phase Lock Circuit
NS5220	Frequency Select
SN72558P, 5558, LM1458 (Dual-Operational Amplifier	Tone Summation Board Modulation Amplifier Localizer/Bearing Control Bearing Check
DM8200 (4-bit Comparator)	Bearing Logic Board
9322 (Quad 2-input multiplexer)	Frequency Control
SN72741L (Single Compensated Op Amp)	Bearing Check Board 30Hz Sine Board Tone Summation Oscillator Modulator Amplifier Phase Lock Circuit Localizer/Bearing Control
74500 (Quadruple 2-input pos NAND Gate)	Digital Readout

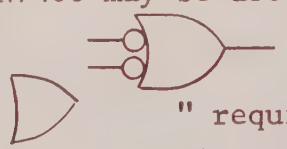
74S112 (Dual J-K Edge triggered Flip-flop)	Digital Readout
DD-700	Digital Readout
MC1027L (100 MHz Flip-flop)	Phase Lock Circuit
MC1666L (300 MHz dual clock R-S Flip-flop)	Phase Lock Circuit
MC1692L (300 MHz Quad Line Receiver)	Phase Lock Circuit
MC1709CG (High performance operative amp)	Bearing Check Tone Summation Modulator Amplifier Localizer Bearing Control
LM309K (5V Voltage Regulator)	Power Supply
LM320K-LM340K +12V (12V voltage Regulator)	Power Supply
LM340K +24V (24V Voltage Regulator)	Power Supply

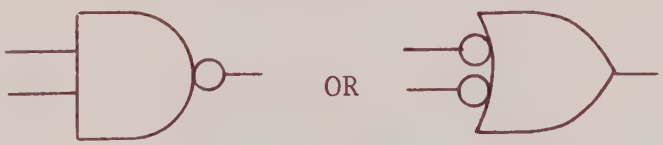
7-16. General Operation of Digital IC's.

7-17. All digital "elements" (gate, counters, comparators, etc.), operates on a two level basis. One level is termed "logic zero" or LO and is any voltage less than 0.8V. (Normally logic zero is 0.2V). The other level is termed

"logic one" or HI and is any voltage greater than 2.0V. (Normally logic one is +3.2V). In positive logic circuits the Logic One is always the more positive voltage level. Negative logic - not used in the NAV-750 - has Logic One the more negative voltage level.

7-18. In paragraph 10-17 is stated that normal logic levels are 0.2V (0) and 3.2V (1). In the prescaler three flip-flops ÷ 2 IC's are used which operate below 0 volts. Logic 0 is 3.3V and logic 1 is 4.1V. Notice logic 1 is still more positive.

7-19. SN7400 and SN7402. These two "quad" gate packs are complementary and thus are very versatile in design. The SN7400 is normally shown as , which indicates it requires two logic one state at the input to cause a logic zero state to occur at the output. The small (zero) shown at the output tells the output tells the output state when the input state is satisfied - in this case two logic one levels (no zeros are indicated). Notice that if either input level goes down to a logic zero the output must go up to a logic one. The SN7400 may be used as a NOR gate in this way as is shown  . Read the symbol as "OR function " requiring a logic zero on either input to cause a one level to appear at the output. Thus the SN7400 is both:



7-20. The SN7402 is the compliment of the SN7400 and thus is normally shown as . Read this symbol to say "it requires a logic one on either input to cause a logic zero output state". This implies that both inputs are used in the zero state and raised to one state during operation. This also means that the output will be up - logic one - only if both inputs are logic zeros. Therefore this gate can also be used as a NAND gate requiri n g two zeros at the input to cause a one at the output. It is drawn as .

The SN7402 is both:

7-21. SN7404 is a hex inverter. It has six inverter stages, each independent from the other.

7-22. The SN7405 is similiar to the SN7404 except it has an open collector output on each stage, this allows the outputs to be tied together for certain applications which the SN7404 can not have done.

7-23. The SN7409 is a quadruple 2 input Pos AND gate . Similiar to the SN7400 except it does not invert at the output. Each output has an open collector stage like the SN7405.

7-24. In form 1 logic schematics (and hopefully in informal work also) the symbol is used which describes the element's function in the particular portion of the circuit it's located in. The SN7410 and SN7420 are three and four input versions, respectively, of the SN7400. They may also be used as:

SN7410

SN7420

7-25. SN7430 Single 8-input NAND gate. The 7430 is an 8-input NAND gate which operates similiar to the SN7400. All 8 inputs must be high for the output to go low. If any input is low the output will go high.

7-26. SN7443 BCD to Decimal Decoder. The 7442 accept 1,2,4,8 BCD data at the inputs and for the corresponding BCD number 0-9 causes one of ten outputs to go low. Therefore four lines of BCD data are decoded into ten lines of data.

7-27. The SN7473 J-K Flip-Flop. Logic element is the basic storage and control element of the NAV-750 logic. It uses one "clock" input which controls the device in conjunction with two other inputs called "J" and "K" inputs. The clock pulse required is a transistion from a "one" to a "zero" state. If "J" is up (logic one) a clock pulse will "set" the flip-flop and cause "Q" output to go to a logic "one" and "$\overline{Q}$" output to go to a logic "zero". (This is the definition of "set".) If K is up the clock pulse will "reset" the flip-flop and cause Q to go down and "$\overline{Q}$" to go up. If both J and K are up the input clock frequency will be divided by two. If only one input is up (J or K) the first clock pulse will either set or reset the device and succeeding clock pulses will have no effect. A direct reset input is provided which when raised to the logic one level will force the SN7473 to reset. As long as the direct reset line is up all clock pulses have no effect - the device will stay reset.

7-28. SN7475. The 7475 is a quad latch. It consists of four identical but independent stages. Data present at the inputs is transferred to the outputs as long as the clock input is high. When the clock input goes low the data that was present at the input at that instant will be stored at the data output.

7-29. SN7476. Similiar to 7473 in operation refer to 7 -27, except the 7476 also has a preset input. If the preset input is brought low the flip-flop will be forced to a set condition with "Q" output high. The clear input operate similiarly. All other functions are the same as the 7473.

7-30. The SN7490 Divider. The SN7490 is an element capable of dividing by 2,5, or 10 in binary format. It requires downward clock transitions to change states and count. Therefore a small logic zero is shown at each clock input. The device uses one flip-flop at the input independent of all others and is used as a divide-by-2 function. Three other flip-flops are internally connected to divide-by-5. When externally connected in series a divide-by-10 function is formed. A logic one on any output indicates that output is to be added to the sum stored at that instant in the SN7490.

7-31. The SN7490 may be reset to either a "zero" count or "nine" count by the application of two logic "one" levels to either the R0 or R9 inputs. Both R0 or R9 inputs must be up (added) to achieve reset. Also, while either R0 or R9 inputs are up all input clock pulses are thrown away and have no effect.

7-32. SN7492 Divider. The SN7492 is an element capable of dividing by 2,6, or 12 in binary format. It requires downward clock transitions to change states any count. The device uses one flip-flop at the input independent of all others as is a ÷ 2 counter. Three flip-flops are internally connected to divide-by-6. Externally connected in series ÷ 12 function is formed. A logic "one" on any output indicates that output value is to be added to the sum stored at that instant in the SN7492. The SN7492 may be reset to a "zero" count by applying two logic "one" levels to the R0 input. While both R0 inputs are up all input clock pulses are ignored and all outputs will be in logic "zero" state.

7-33. SN7493 4-Bit Binary Counter. The 7493 is a divide by 2,8 or 16 counter. It is similiar in operation to the 7490 except it is a binary counter. It has a common reset to "zero" for all four stages.

7-34. SN74121N Monostable Multivibrator. The SN74121N is a one-shot element with gated inputs. External R and C values must be added to form pulse widths from 40ns to 40sec. Three inputs provide selective gating. If B is held at a logic "one" state, a logic "zero" on either A1 or A2 will trigger an output pulse; or if either A1 or A2 is held low an upclock on B will trigger a pulse. The device is used in the NAV-750 to widen an extremely narrow reset pulse to useable proportions.

7-35. SN74123. Dual One-Shot operates the same as the 74121 except there are two in one package.

7-36. SN74190 Sycronous Up/Down Decade Counter. One line controls whether the device counts up or counts down. All output stages change state at the same time. Typical clock frequencies are in excess of 20 MHz.

7-37. SN74191 Sycronous Up/Down Four Bit Binary Counter. The SN74191 is the same as the SN74190 except it is a binary counter.

7-38. NS5220 Special Program ROM (Read Only Memory). It takes BCD data in from the Frequency Select circuit which is true BCD data and it changes it according to a prescribed program into data which is directly related to the frequency sequence needed to control the generator output frequency. To varify ROM operation, check the input to ROM to agree BCD wise directly to the frequency that is selected. This verifies circuitry between frequency select switches or memory and the ROM. To check output, once the input is varified as to being correct the frequency present at the plug at the back of PC-7 or the generator output frequency must be that selected.

7-39. 72558P, 5558, or LM1458. These dual operational amplifiers contain two operational amplifiers with each electrically similar to the SN72741. All internal frequency compensation keeps external components to a minimum. They are used wherever a general purpose amplifier is required. These three are interchangeable in operation.

7-40. DM8200 Four Bit Comparator. The DM8200 is a comparator that samples two four bit binary inputs, compares their numerical values, and gives outputs telling whether one input is greater than, equal to or lesser than the other. In the NAV-750, only the equality function is used. Whenever the input or A1 = B1, A2 = B2, A3 = B3 and A4 = B4, both outputs will go to a logic one state. Otherwise one output or the other will be down at logic zero.

7-41. 9322 Quad Two-Input Multiplexer. The 9322 is basically a four pole, double throw (4PDT) switch. Data is selected from one of two inputs on each switch and routed to a common output. An Enable input must be low for operation. If Enable is high all outputs are at logic 'zero' regardless of inputs. In the NAV-750 the Enable is wired to ground. If the Select input is high true data from all the "one" (1a, 1b, 1c, and 1d) inputs will be present at the Z outputs (Za, Zb, Zc, and Zd). If Select is low true data from all the 'zero' inputs (0a, 0b, 0c, and 0d) will be present at the Z outputs. It is TTL type logic and requires 5V for operation.

7-42. SN72741L and LM709 Single Compensated Op Amp. The SN72741 is a single operational amplifier with internal frequency compensation. It is used when a high performance op amp is required.

7-43. 74500 Schottky Quadruple Two Input Pos NAND Gate. Identical to SN7400 discribed in 10-19 except it is capable of speeds of 80 MHz where as the SN7400 is capable of 20 MHz maximum.

7-44. 74S112 Schottky Dual J-K Edge Triggered Flip-Flop. Like the 74S00 in 10-43, the 74S112 is capable of speeds of 80 MHz.

7-45. The DD-700 BCD to 7-Bar HV Display Decoder. The DD-700 is designed to operate high voltage gas-discharge readouts such as the Sperry used in the NAV-750. It can safely handle output voltage a s high as 180-200 volts. The DD-700 requires a 5V power supply for it's own operation. It's current regulates the output to maintain even display brightness.

7-46. MC1027L 100 MHz Flip-Flop. The MC1027 is a single, high speed flip-flop designed to operate at frequencies of 100 MHz minimum. In the NAV-750 it is used in the Phase Lock circuit. The device was designed to run from a negative voltage, therefore VCC is tied to ground and operates near A+, a logic one being 3.2V. Level shifters are incorporated at the output of the dividers to translate the 1027 logic levels to the TTL logic levels (0.8V and 2.0). Multiple "ORED" J and K inputs are provided, of which on J and K inputs are tied together to form a single clock input and other inputs are used as needed to form a divide-by-five function. All unused inputs are tied to ground.

7-47. MC1666L Greater than 300 MHz Dual Clock R-S Flip-Flop. The MC1666L is a dual, high-speed flip-flop with speeds up to 400 MHz. In the NAV-750 the first flip-flop is required to toggle up to 330 MHz, the second to 165 MHz.

The flip-flop is a set-reset type which requires a clock input to enable the set-reset input and change output states.

7-48. MC1692 400 MHz Quad Line Receiver. The MC1692 is a quad, two-input gate pac utilized as a driver for high-speed counting in excess of 400 MHz. As applied in the NAV-750 max response necessary is 330 MHz.

7-49. MC1709CG High Performance Operational Amp. The MC1709CG is a higher speed high performance operational amp. It requires external frequency compensation otherwise operates similiar to the SN72741L.

7-50. LM309K, LM340K-12, and LM340K-24 Voltage Regulators. These are one piece integrated positive voltage regulators, complete in themselves. They require no external components except for transformers, rectifiers and filter capacitors. Each regulator is set for specific voltage depending on part number.

7-51.

7-52.

7-53. Intentionally omitted

7-54.

7-55.

7-56. Operational Checking of IC's.

7-57. The usual method of verifying that an IC of any function is working properly is to observe it in action in the circuit. If the IC is of TTL (Transistor-transistor logic), which most all the IC's are in the NAV-750, the input levels must go below 0.4V and above 2.4 for well defined logic "zero" and "one" levels. Output levels usually will go from 0.2 or 0.3V to 3.2V. Gate packs must perform per their logic functions which can be verified with an oscilloscope. Counter IC's should divide the input clock frequency by 2,4,8, and 10 observing the 20 (1 or A), 21 (2 or B), 22 (4 or C) and 23 (8 or D) output. Different output designations which all mean the same thing.

7-58. IC's of any type are designed to sense changing voltage levels at their inputs. This causes them to be particularly sensitive to both power buss variations and noise picked up in various ways on the toggle or clock lines. When IC failure is suspected always observe the A+ leads near the IC's. Be aware of transients from external sources great enough in amplitude to fall below 1.5V. Sometimes a faulty IC will introduce transients onto clock lines to other IC's making them appear faulty also.

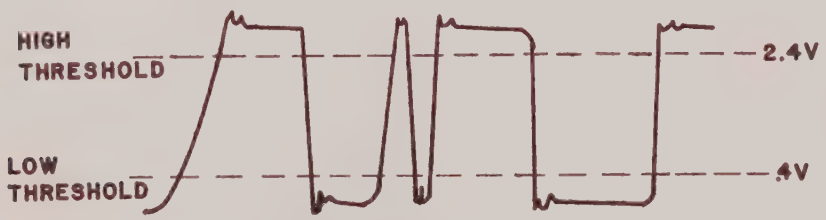


Fig 7-1

Figure 7-1. TTL Signal. In the digital world, the relative value of signal voltage with respect to the threshold voltages determines the operation of the circuit. A signal above the high threshold is in the high state and whether it is 2.8V or 3.0V is unimportant to the operation of the circuit.

7-59. Figure 7-1 shows a typical TTL (Transistor-Transistor-Logic) signal. This might as well be any analog signal when viewed on an oscilloscope. The oscilloscope displays absolute voltage with respect to time, but in the digital world absolute values are unimportant. A digital signal exists

In one of two or three states--high, low, and undefined or in-between level--each determined by a threshold voltage. It is the relative value of the signal voltage with respect to these thresholds that determines the state of the digital signal and this digital state determines the operation of the IC, not absolute levels. In Figure 7-1 if the signal is greater than 2.4 volts, it is a high state and it is unimportant whether the level is 2.8 or 3.0 volts. Similarly for a low state the voltage must be below .4 volts. It is not important what the absolute level is as long as it is below this threshold. Thus when using an oscilloscope, the troubleshooter must over and over again determine if the signal meets the threshold requirements for the desired digital state.

7-60. Within a digital logic family, such as TTL, the timing characteristics of each component are well defined. Each gate in the TTL logic family displays a characteristic propagation delay time, rise time, and fall time. The effects of these timing parameters on circuit operation are taken into account by the designer. Once a design has been developed beyond breadboard or prototype stage and is into production, problems due to design have hopefully been corrected. An important characteristic of digital IC's is that when they fail, they fail catastrophically. This means that timing parameters rarely degrade or become marginal. Thus observing on an oscilloscope and making repeated decisions on the validity of timing parameters is time consuming. Once problems due to design are corrected, the fact that pulse activity exists is usually enough indication of proper IC operation without further observation of pulse width, repetition rate, rise time or fall time.

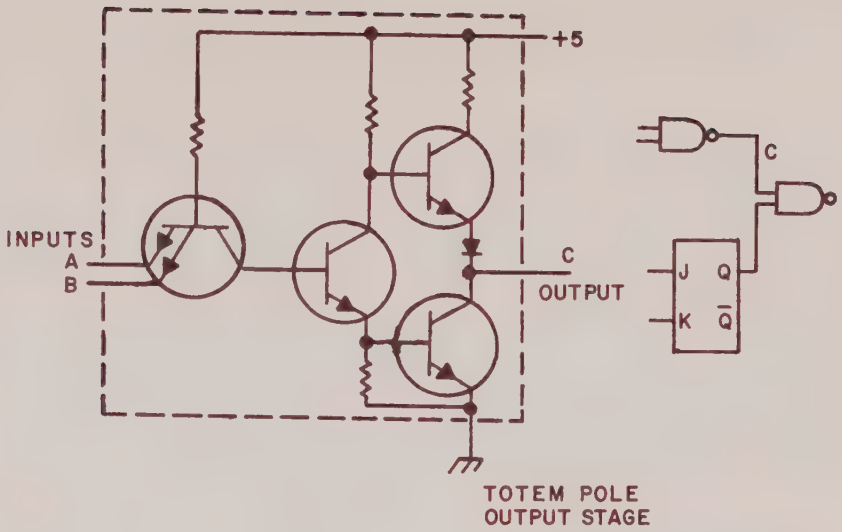


Fig. 7-2

Figure 7-2. When stimulating a node in circuit, such as C above, it is necessary to override the low impedance totem pole output stage driving that node. When the output is in the low state, it is a saturated transistor to ground. Presently used signal sources are not powerful enough to override this low state.

7-61. Figure 7-2 shows a problem created by the TTL logic family. The output stage of a TTL device is a transistor totem pole. In either the high or low state, it is a low impedance. In the low state it is a saturated transistor to ground. It thus appears as 5--10 ohms to ground. This presents a problem to in-circuit stimulation. A signal source used to inject a pulse at a node which is driven by a TTL output must have sufficient power to override the low impedance output.

FAILURE MODES OF DIGITAL IC'S

7-62. In order to troubleshoot efficiently, it is important to understand the type of failures found in digital circuits. These can be categorized into two main classes--those caused by a failure internal to an IC and those caused by a failure in the circuit external to the IC.

7-63. There are four types of failures that can occur internally to an IC. These are (1) an open bond on either an input or output, (2) a short between an input or output and Vcc or ground, (3) a short between two pins (neither of which are Vcc or ground), and (4) a failure in the internal circuitry (often called the steering circuitry) of the IC.

7-64. In addition to these four failures internal to an IC, there are four failures that can occur in the circuit external to the IC. These are (1) a short between a node and Vcc or ground, (2) a short between two nodes (neither of which are Vcc or ground), (3) an open signal path, and (4) a failure of an analog component.

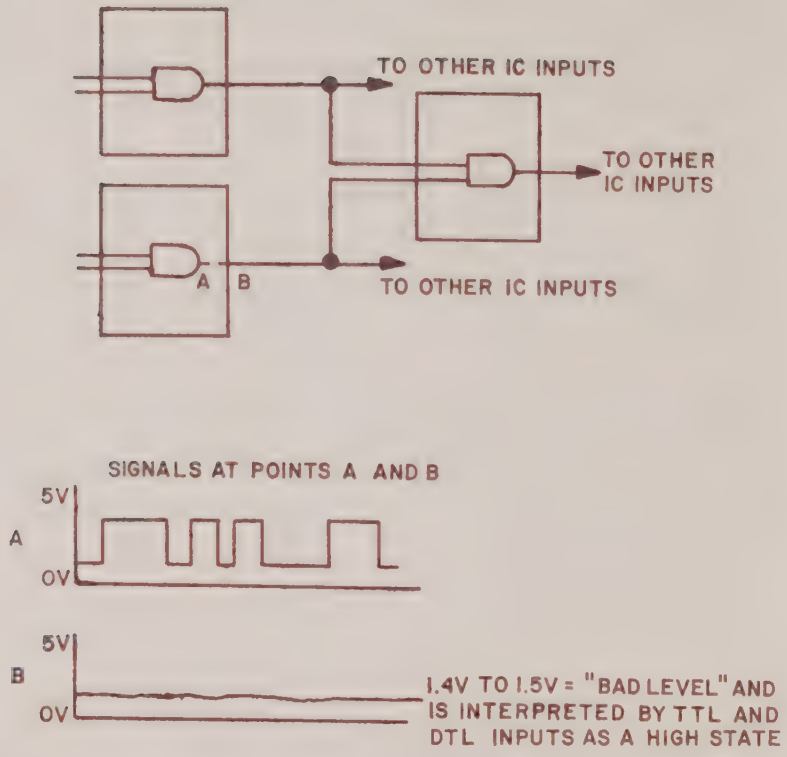


Fig. 7-3

Figure 7-3. The Effect of an Open Output Bond Upon Circuit Operation. An open output bond allows all inputs driven by that output to float to a "bad level". This level is usually interpreted as a logic high state by the inputs. Thus the inputs driven by an open output bond will respond as though a static logic high signal was applied.

7-65. Before discussing how to detect each of these failures we will discuss the effect each has upon circuit operation. The first failure internal to the IC mentioned was an open bond on either an input or output. This failure has a different effect depending upon whether it is an open output bond or an open input bond. In the case of an open output bond (Figure 7-3), the inputs driven by that output are left to float. In TTL and DTL circuits a floating input rises to approximately 1.4 to 1.5 volts and usually has the same

effect on circuit operation as a high logic level. Thus an open output bond will cause all inputs driven by that output to float to a bad level since 1.5 volts is less than the high threshold level of 2.0 volts and greater than the low threshold level of .4 volts. In TTL and DTL, a floating input is interpreted as a high level. Thus the effect will be that these inputs will respond to this bad level as though it were a static high signals.

7-66. In the case of an open input bond (Figure 7-4), we find that the open circuit blocks the signals driving the input from entering the IC chip. The input on the chip is thus allowed to float and will respond as though it were a static high signal. It is important to realize that since the open occurs on the input inside the IC, the digital signal driving this input will be unaffected by the open and will be detectable when looking at the input pin (such as at Point A in Figure 7-4). The effect will be to block this signal inside the IC and the resulting IC operation will be as though the input were a static high.

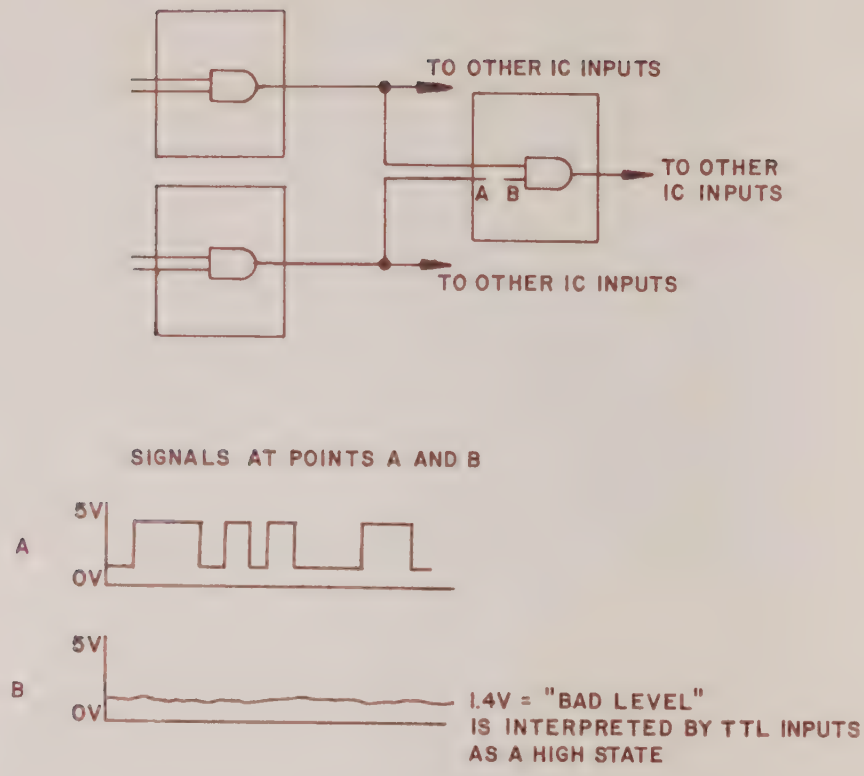


Fig. 7-4

Figure 7-4. The Effect of an Open Input Bond Upon Circuit Operation. An open bond on an input has the effect of blocking the input signal from reaching the chip and allows the input of the chip to float to a "bad level". Thus even though the signal can be viewed at an external point such as Point A, the input of the chip responds to the "bad level" as though it were a static high level.

7-67. A short between an input or output and Vcc or ground has the effect of holding all signal lines connected to that input or output either high (in the case of a short to Vcc) or low (if shorted to ground)(Figure 7-5). In many cases, this will cause expected signal activity at points beyond the short to disappear and thus this type of failure is catastrophic in terms of circuit operation

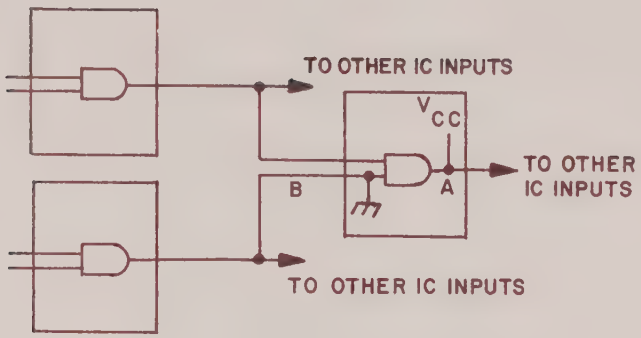
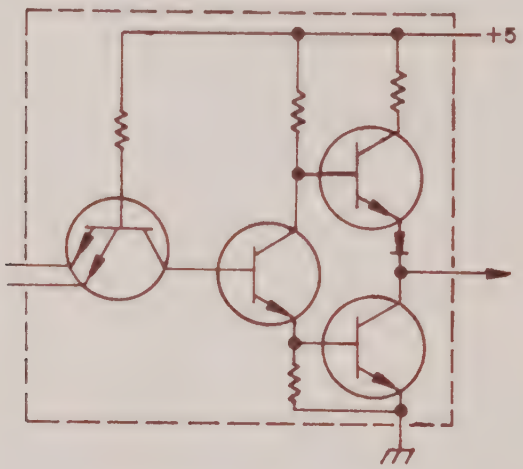


Fig. 7-5

Figure 7-5. The Effect of a Short Between an Input or Output and Vcc or Gnd. All signal lines connected to Point A are held in the high state. All signal lines connected to Point B are held in the low state.

7-68. A short between two pins is not as straightforward to analyze as the short to Vcc or ground. When two pins are shorted the outputs driving those pins oppose each other when one attempts to pull the pins high while the other attempts to pull them low (Figure 7-8). In this situation the output attempting to go high will supply current through the upper saturated transistor of its totem pole output stage while the output attempting to go low will sink this current through the saturated lower transistor of its totem pole output stage. The net effect is that the short will be pulled to a low state by the saturated transistor to ground. Whenever both outputs attempt to go high simultaneously or to go low simultaneously, the shorted pins will respond properly. But whenever one output attempts to go low the short will be constrained to be low.

7-69. The fourth failure internal to an IC is a failure of the internal (steering circuitry of the IC (Figure 7-6). This has the effect of permanently turning on either the upper transistor of the output totem pole thus locking the output in the high state or turning on the lower transistor on the totem pole thus locking the output in the low state. Thus this failure blocks the signal flow and has a catastrophic effect upon circuit operation.



STEERING CIRCUITRY

Fig.7-6

Figure 7-6. The Effect of a Failure of the Internal Circuitry of the IC Upon Circuit Operation. A failure of the steering circuitry of an IC will either cause the output to be in a static high state or a static low state.

7-70. A short between a node and Vcc or ground external to the IC is indistinguishable from a short internal to the IC. Both will cause the signal lines connected to the node to be either always high (for shorts to Vcc) or always low (for shorts to ground). When this type of failure is encountered only a very close physical examination of the circuit will reveal if the failure is external to the IC.

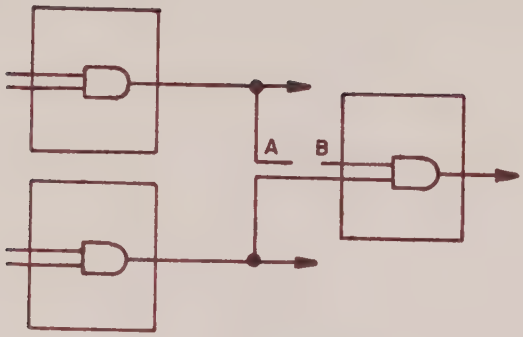


Fig. 7-7

Figure 7-7. The Effect of an Open in the Circuit External to an IC. All inputs attached to the node at Point A will be driven properly. All inputs to the right of the open (Point B) will be left to float to a "bad level" and will therefore look like a static high state.

7-71. An open signal path in the circuit has a similar effect as an open output bond driving the node (Figure 7-7). All inputs to the right of the open will be allowed to float to a bad level and will thus appear as a static high level in circuit operation. Those inputs to the left of the open will be unaffected by the open and will thus respond as expected.

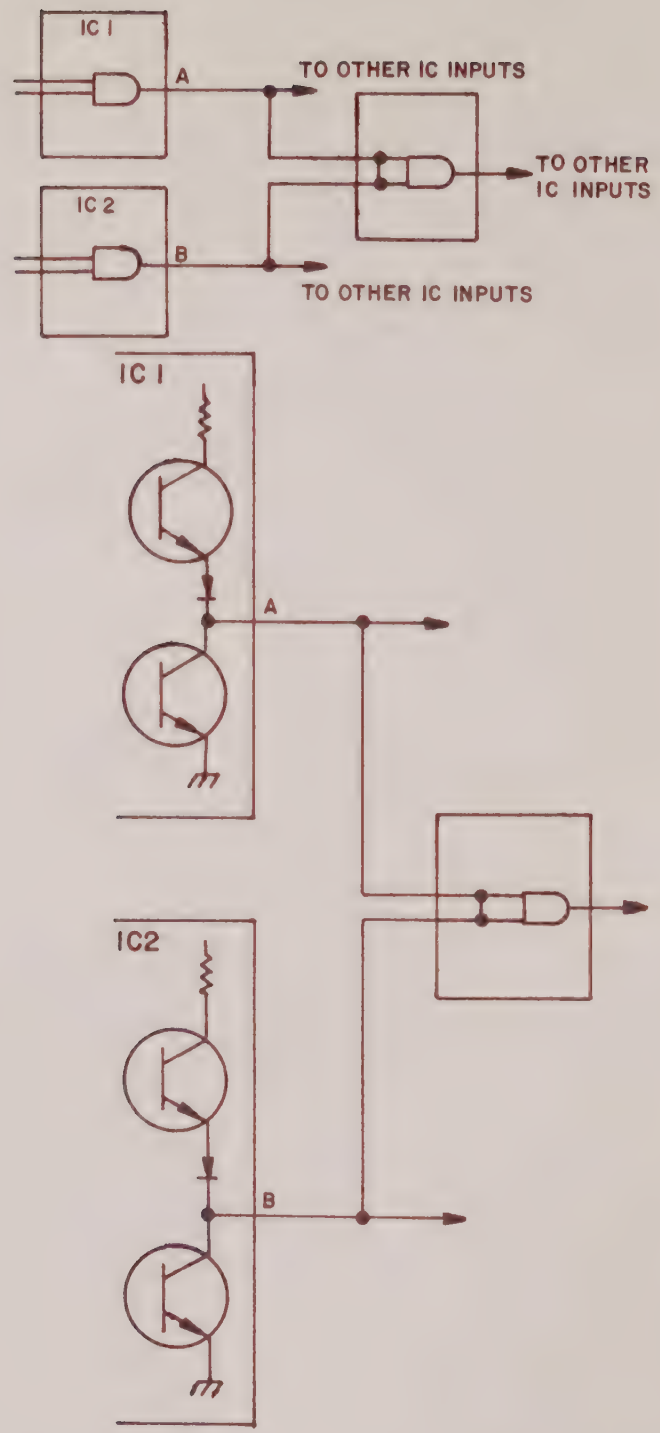


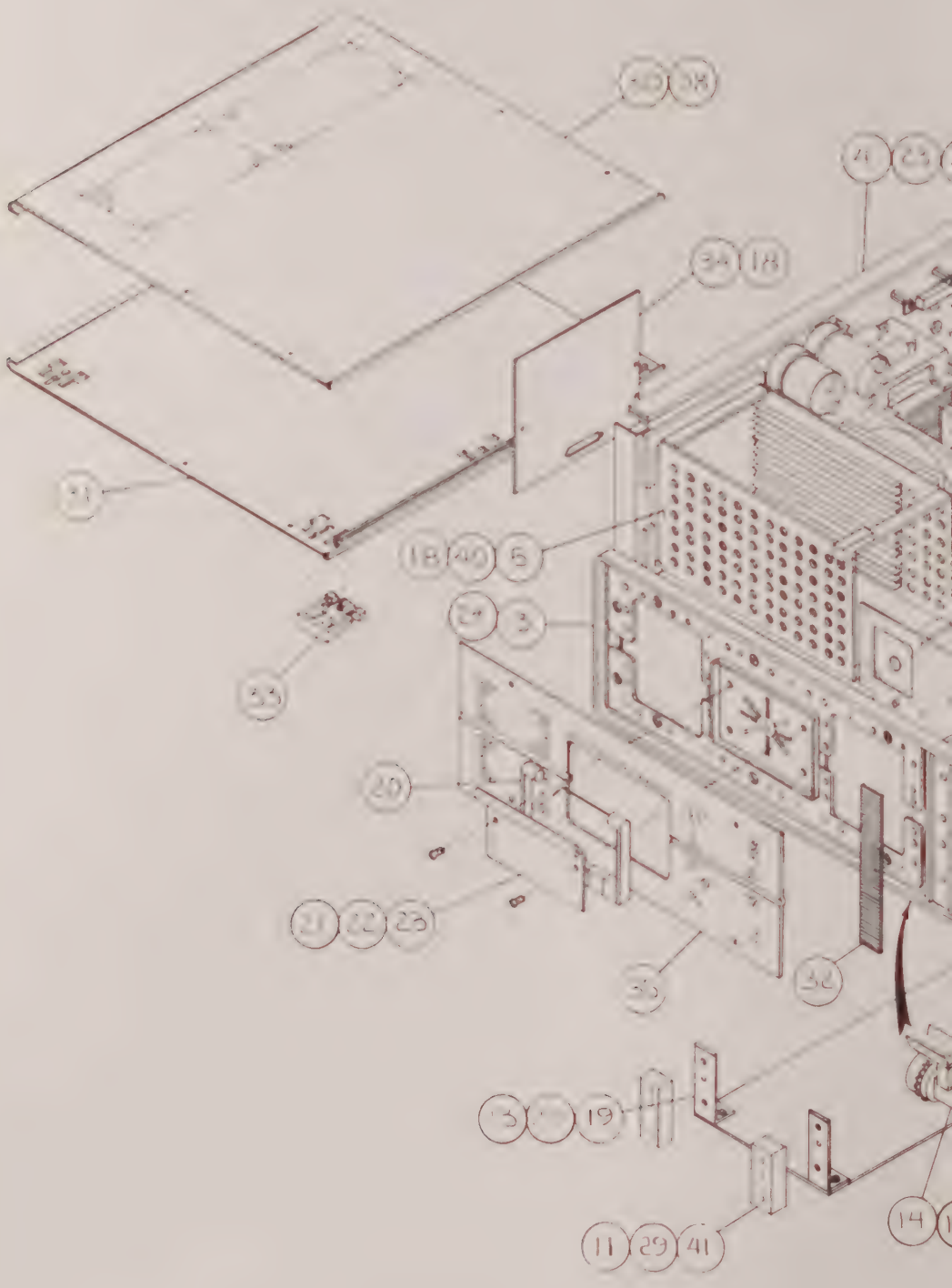
Fig. 7-8

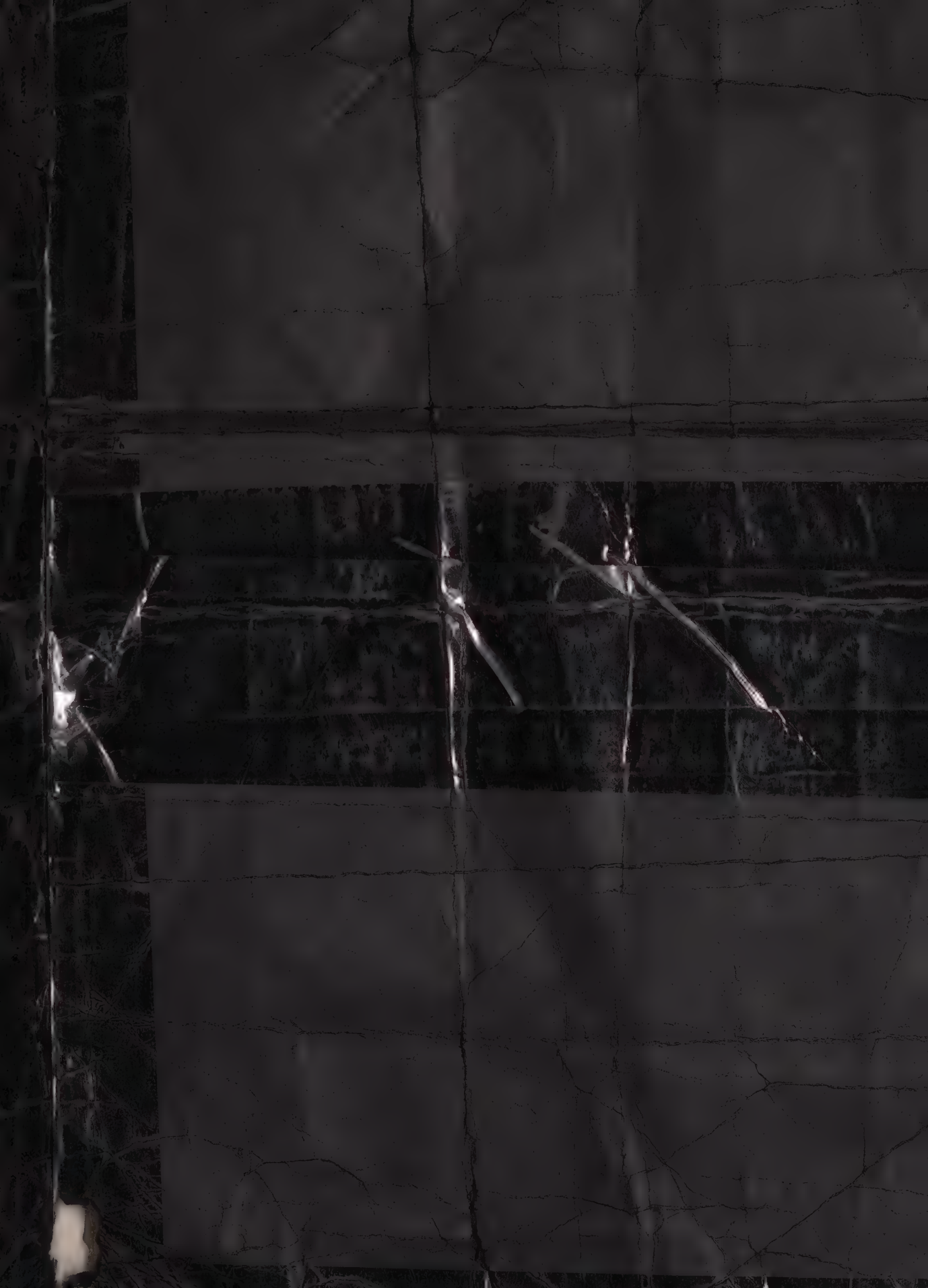
Figure 7-8. The error effect of a short between two pins occurs when the outputs driving those pins attempt to pull the short to opposite states. In this case, the output attempting to pull the node high will be supplying current while the output attempting to pull the node low is a saturated transistor to ground and will be sinking the current. The saturated transistor to ground will thus pull the node to a low state.

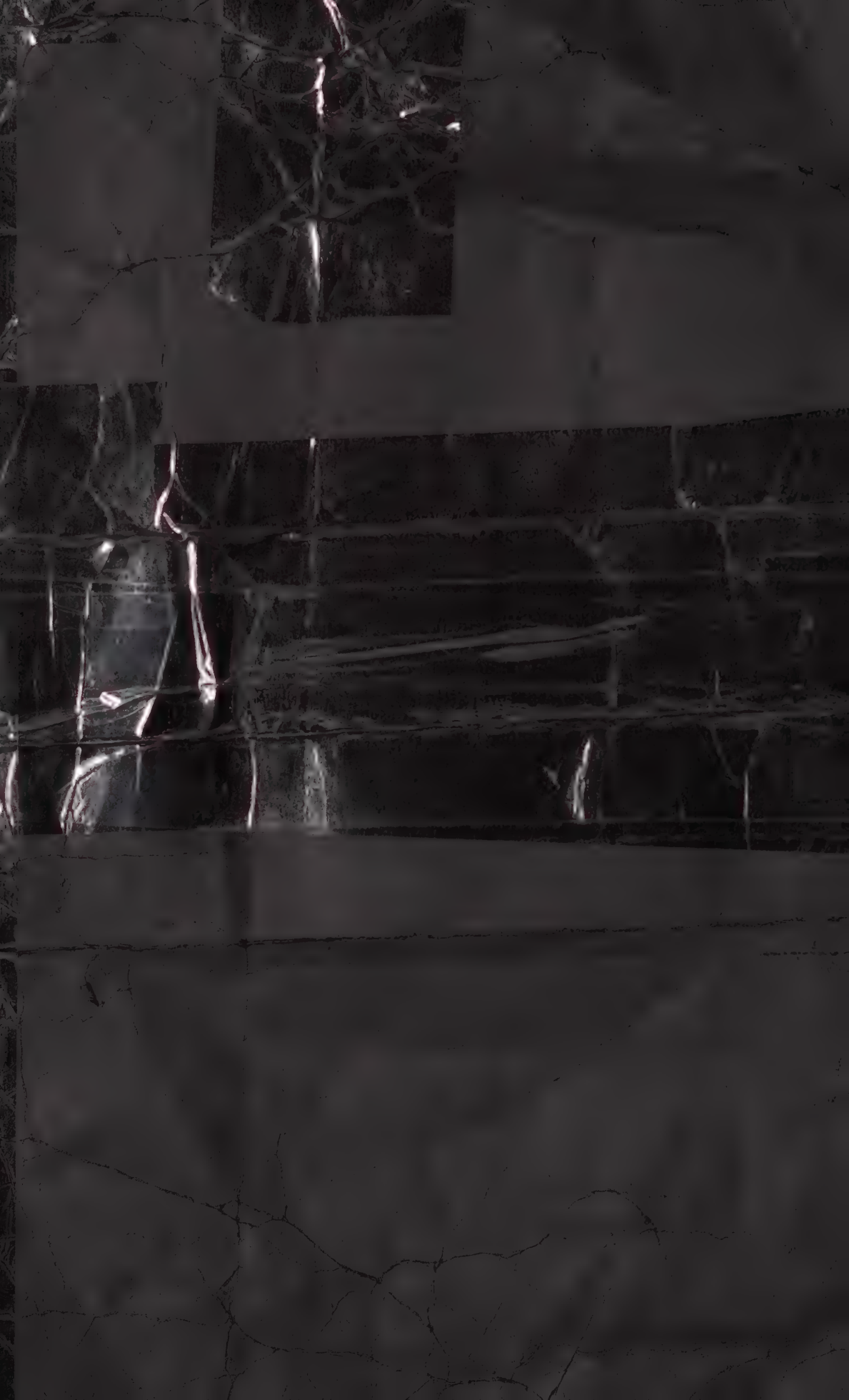
R E F E R E N C E S

I. Hewlett-Packard, Application Note 163-1, "Techniques of Digital Troubleshooting".

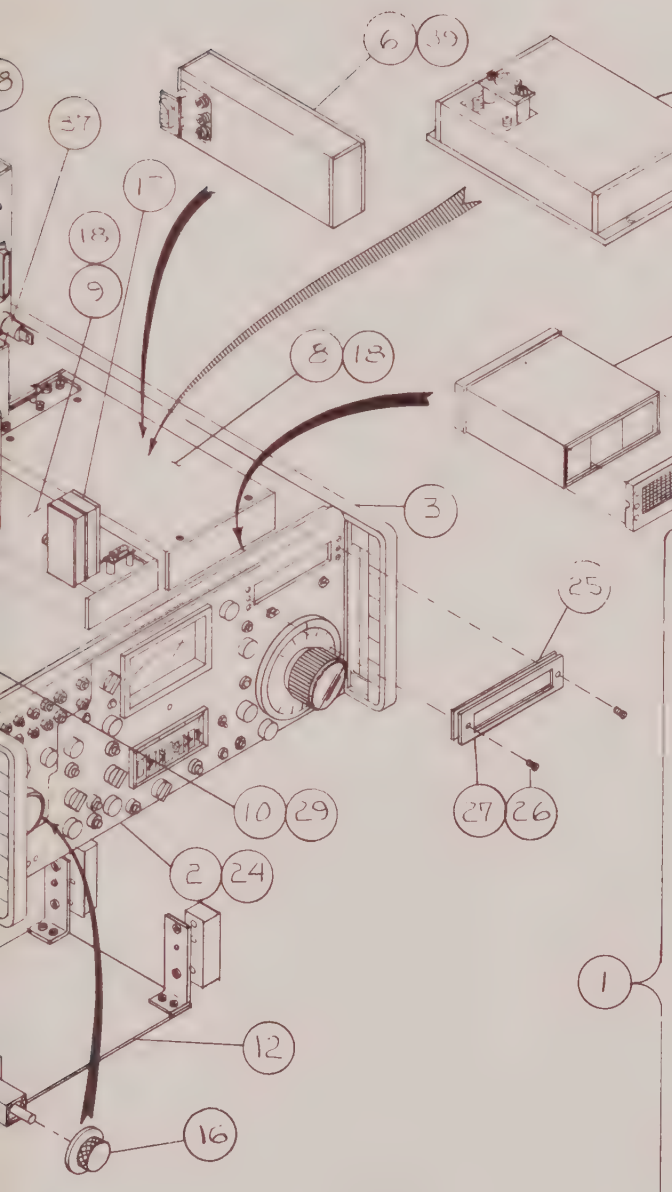
II. King Radio Corporation, KWX-40 Weather Radar, Maintenance/Overhaul Manual, Section VI.







DATE	REV	CHANGE	APP'D



ITEM	REQ'D	PART NO.	DESCRIPTION
41	8	6-32x3/4	PHIL. FLAT HD. SCW
40	1	4-40x3/8	PHIL. BIND HD SCW.
39	3	8-32x1/4	PHIL. FLAT HD. SCW.
38	16	440x1/4	PHIL. FLAT HD SCW.
37	1	1-16-0125	BUFFER AMP ASS'Y.
36	1	1-16-0187	8 STEP OSC. ASS'Y.
35	2	3-76-0021	SIDE COVER.
34	1	1-16-0087	CARD CAGE COVER
33	5	2-76-0068	FOOT ASS'Y.
32	2	1-760070	TRIM STRIP
31	1	3-76-00666	BOTTOM COVER
30	1	3-76-0065	TOP COVER
29	17	#6-32x1/4	PHIL. FLAT HD. MACH. SCW.
28	4	#8-32x1/4	PHIL. BIND HD. MACH SCW.
27	1	1 16-0083	BEZEL COUNTER
26	2	#C-56x5/16	BLACK ANODIZED PHIL. SCW. BIND HD.
25	1	1-16-0207	LENS
24	8	#8-32x5/16	PHIL. SCW - FLAT HD.
23	8	#8	INT. TOOTH LW.
22	4	#8-32x3/8	PHIL. FLAT. HD. MACH. SCW.
21	2	2-1600069	HANDLE MTG. PLATE
20	2	3-76-00657	HANDLE SIDE COVER
19	8	#6	INT. TOOTH L. W.
18	12	#6-32x5/16	PHIL.BIND HD. MACH. SCW.
17	1	1 16-0161	DUAL BUFFER AMP ASS'Y.
16	1	2-00-0130	1" DIA. KNOB ASS'Y.
15	8	#4-40x5/16	PHIL. SCW. - FLAT HEAD
14	1	2-16-0045	BRG. SELECT ASS'Y.
13	4	2-14-0243-1	MTG. FOOT
12	1	3-16-0057	FLOOR PLATE
11	4	2-14-02432	MOUNTING SPACER
10	1	2-16-0115	CHANEL ENCL. ASS'Y.
9	1	3-16-00556	MOD./AMP. MECH. ASS'Y.
8	1	3-16-0054	PHASE LOCK MECH. ASS'Y.
7	1	3-16-00534	DIGITAL READOUT & DISPLAY ASS
6	1	2-16-0055	OSC. MECH. ASS'Y.
5	1	3-16-00536	CARD CAGE ASS'Y.
4	1	3-16-0106	REAR PANEL ASS'Y (INSIDE)
3	2	3-76-0062	SIDE FRAME PANEL
2	1	3-16-0105	FRONT PANEL ASS'Y.
1	1	2-16-0052	NAV-750 COMPOSITE

NEXT ASS'Y	QT'Y	MODEL
	1	NAV-750

APPLICATION

LIST OF MATERIALS

NOTE:

1 ▷ 8 STEP OSC. USED IN NAV-750A ONLY.

FIG. 8-1

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

MATERIAL NOTED
TREATMENT
FINISH

DRAWN DATE 1-2-75
CHECKED DATE 2-17-75
APPROVED DATE 2 18-75

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE NAV-750 ASSEMBLY (COMPOSITE)

SIZE — PART NUMBER 3-16-0052 REV
SCALE NONE WEIGHT SHEET 1 OF 1

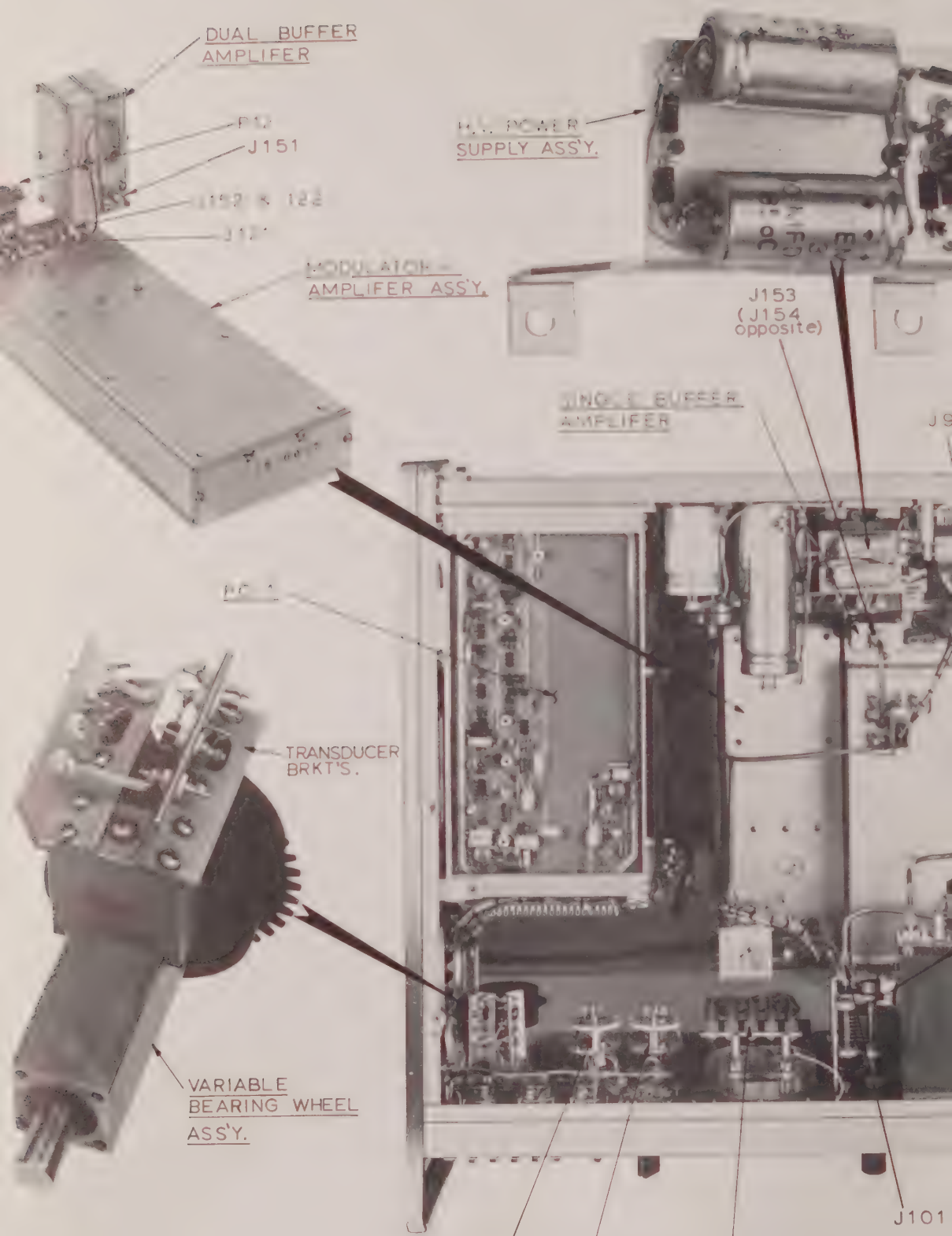
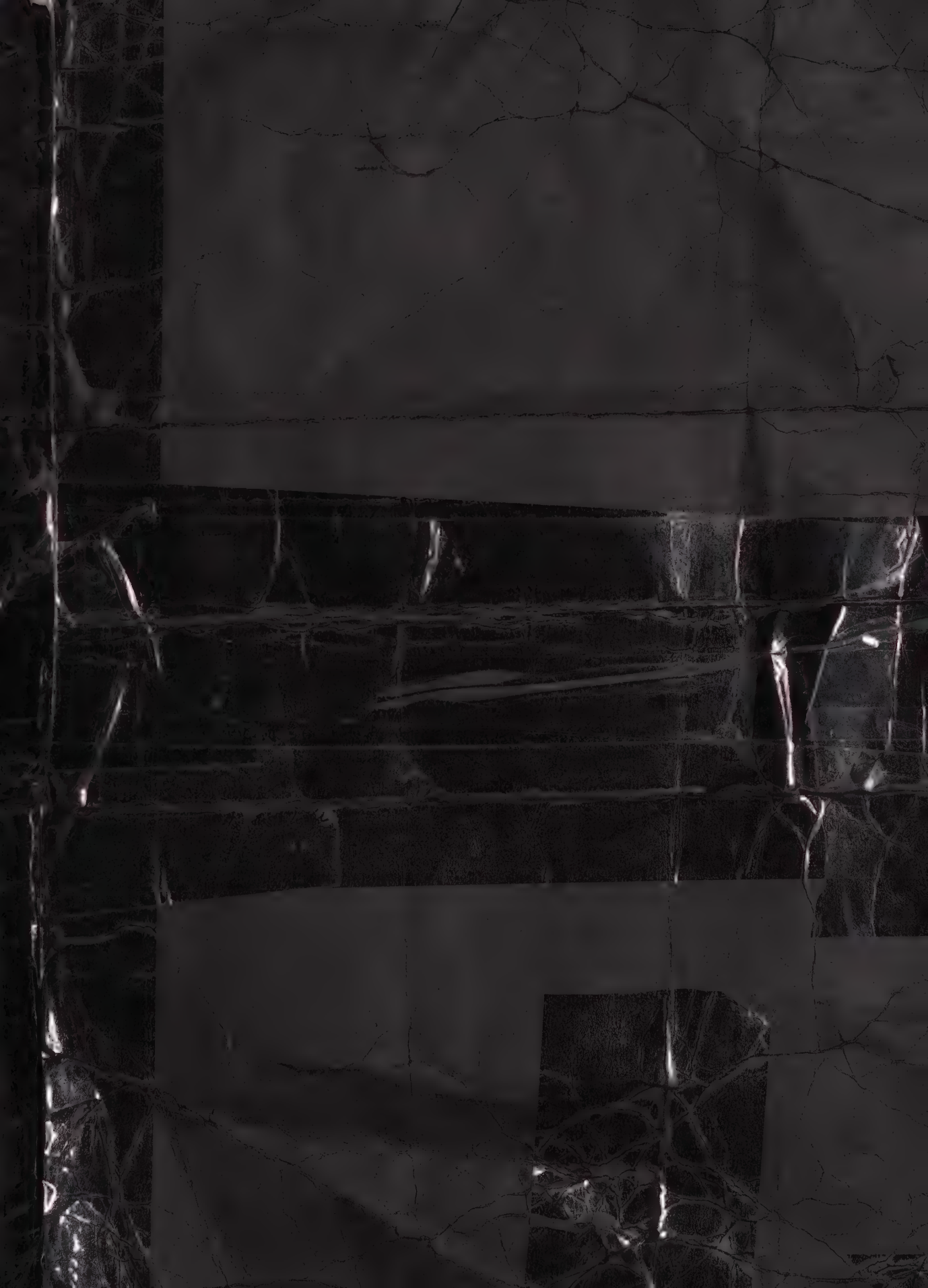
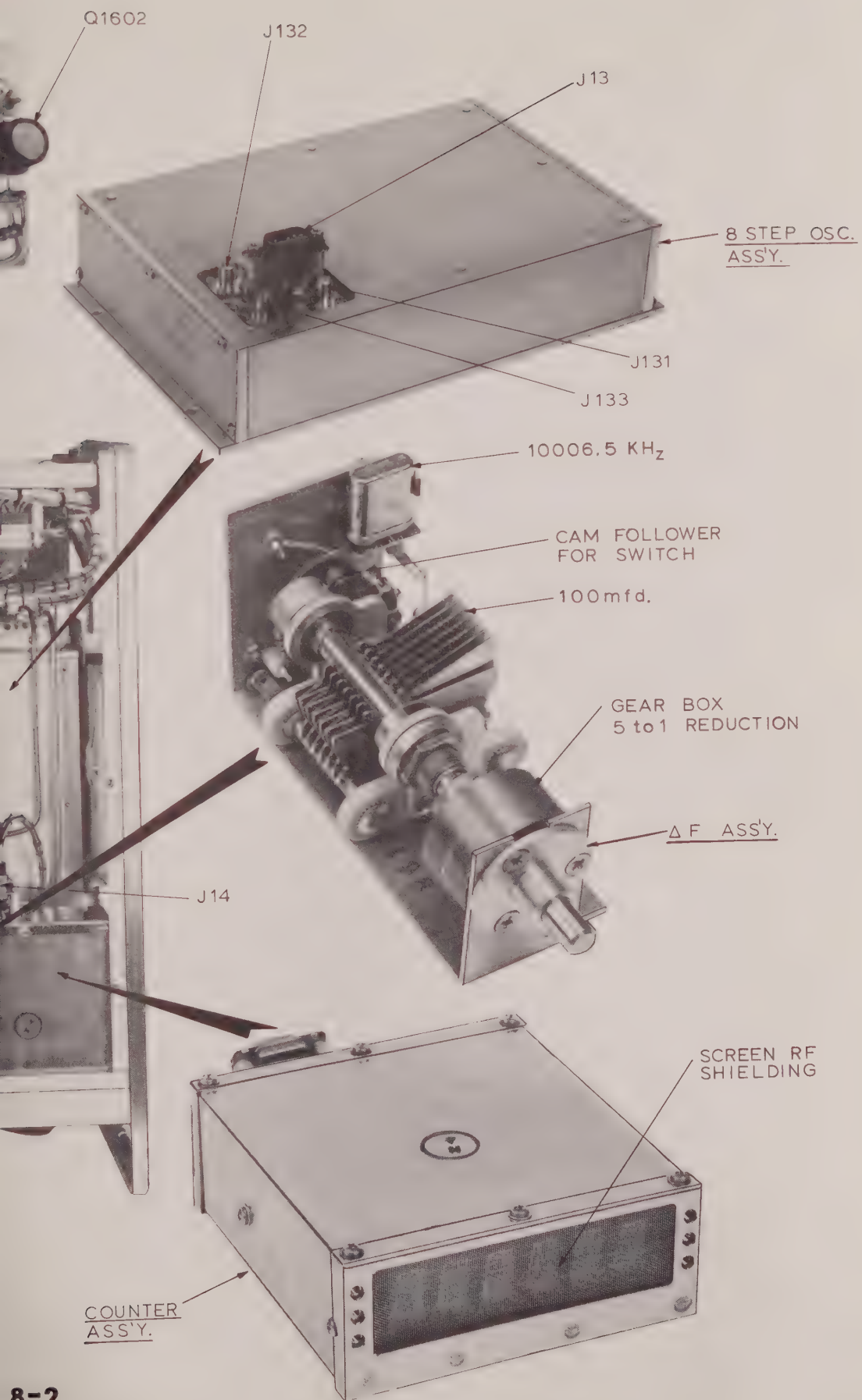
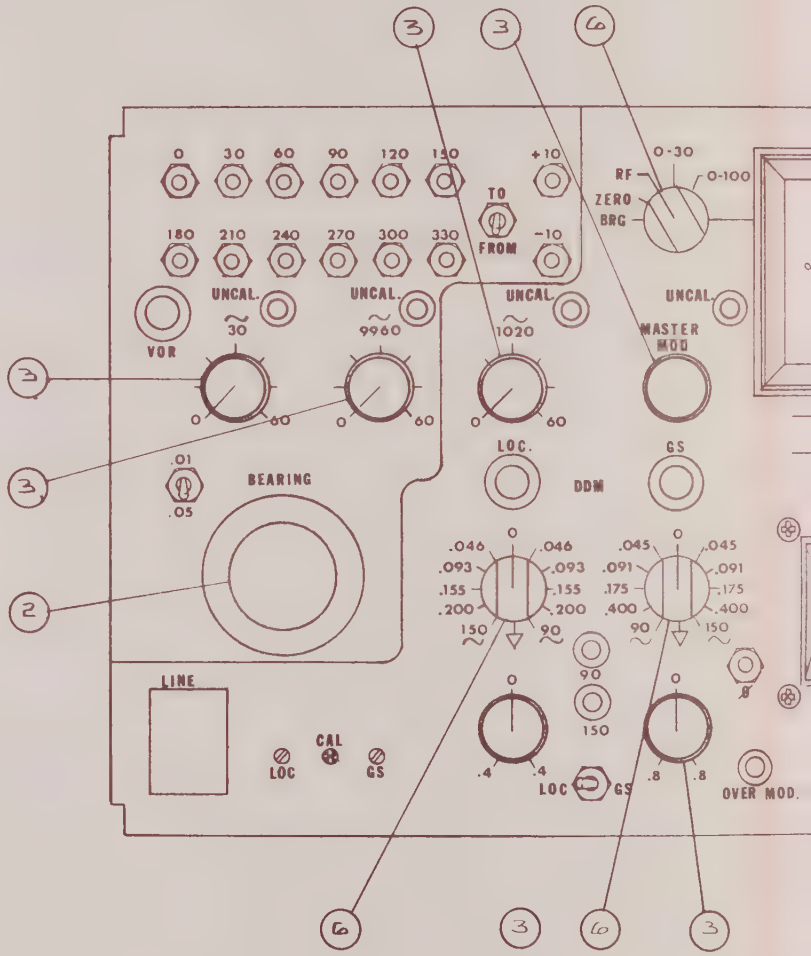

DUAL BUFFER AMPLIFER
P12
J151
MODULATOR AMPLIFER ASS'Y.
H.V. POWER SUPPLY ASS'Y.
J153 (J154 opposite)
SINGLE BUFFER AMPLIFER
TRANSDUCER BRKT'S.
VARIABLE BEARING WHEEL ASS'Y.
J101
G/S DDM. SWITCH ASS'Y.
FREQUENCY SELECT SWITCH ASS'Y.
LOC. DDM. SWITCH ASS'Y.

FIG.




Q1602
J132
J13
8 STEP OSC. ASS'Y.
J131
J133
10006.5 KHz
CAM FOLLOWER FOR SWITCH
100mfd.
GEAR BOX 5 to 1 REDUCTION
Δ F ASS'Y.
J14
SCREEN RF SHIELDING
COUNTER ASS'Y.


0
30
60
90
120
150
+10
180
210
240
270
300
330
-10
TO
FROM
0-30
RF
ZERO
BRG
0-100
UNCAL.
VOR
30
9960
1020
MASTER MOD
LOC.
GS
DDM
.01
.05
BEARING
.046
.093
.155
.200
.045
.091
.175
.400
LINE
CAL
LOC
GS
OVER MOD.

DATE	REV	CHANGE	APP'D
1-9-75	A	INC. ECN # 1 JNV. LD	
1-10-75	B	REDRAWN.	

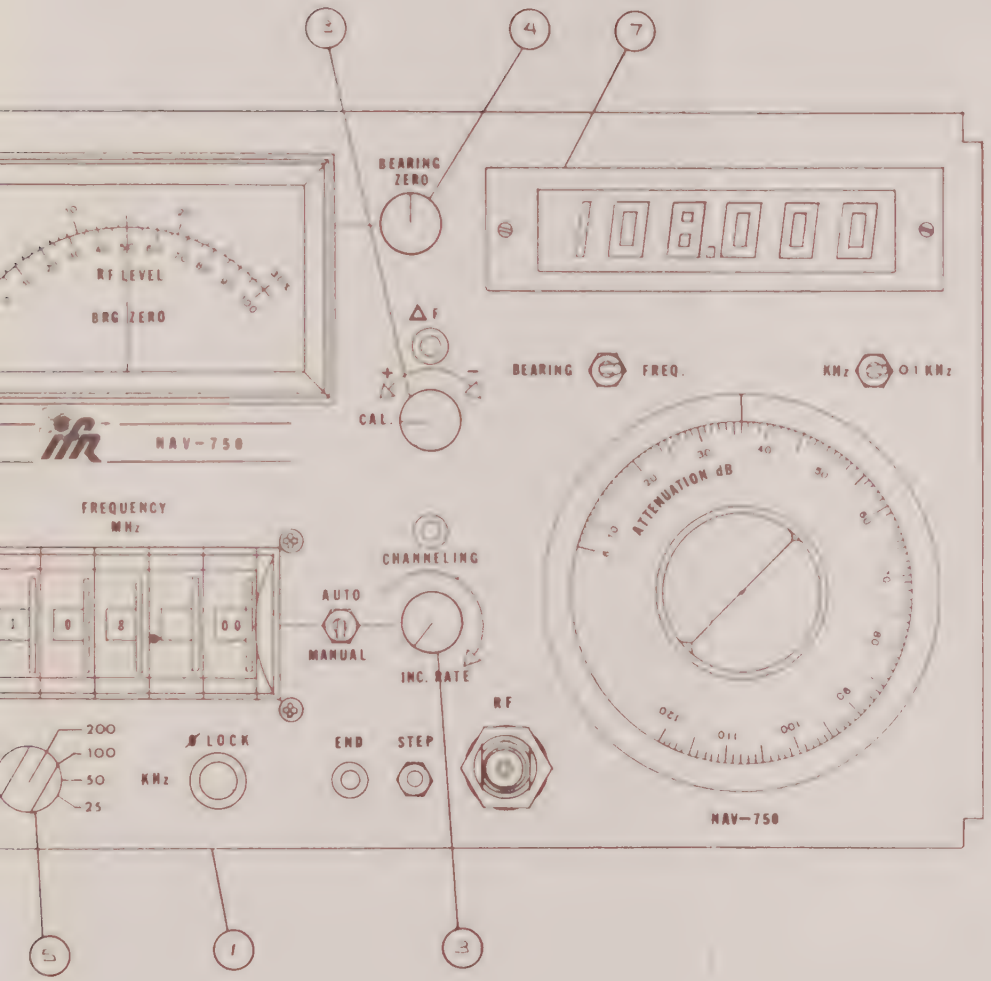


FIG. 8-3

ITEM	QTY	PART NO.	DESCRIPTION
7	1	16-0083	BEZEL ASS'Y.
6	3	60-0056-2	BAR KNOB
5	1	60-0056-1	BAR KNOB
4	1	60-0057-1	ROUND KNOB
3	3	60-0057-2	ROUND KNOB
2	1	00-0130	DIAL KNOB ASS'Y
1	1	16-0105	FRONT PANEL ASS'Y

NEXT ASS'Y	QTY	MODEL
	1	NAV-750

APPLICATION

LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS .XX = ± .010 .XXX = ± .005
ANGLES ± 1/2°
FRACTIONS ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN [illegible] DATE 1-9-75
CHECKED [illegible] DATE 1-22-75
APPROVED [illegible] DATE 1-29-75

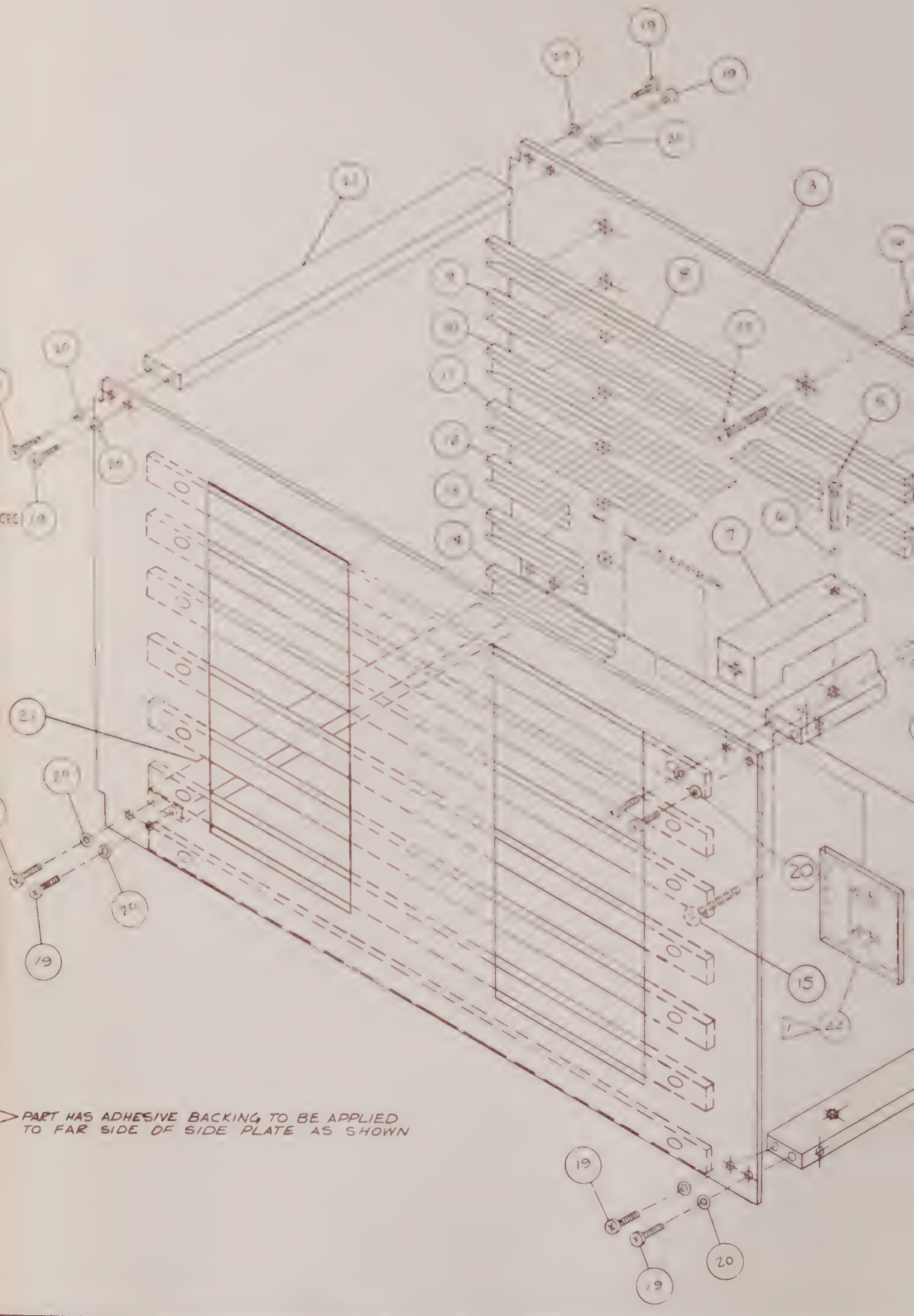
MATERIAL ASS'Y.
TREATMENT
FINISH

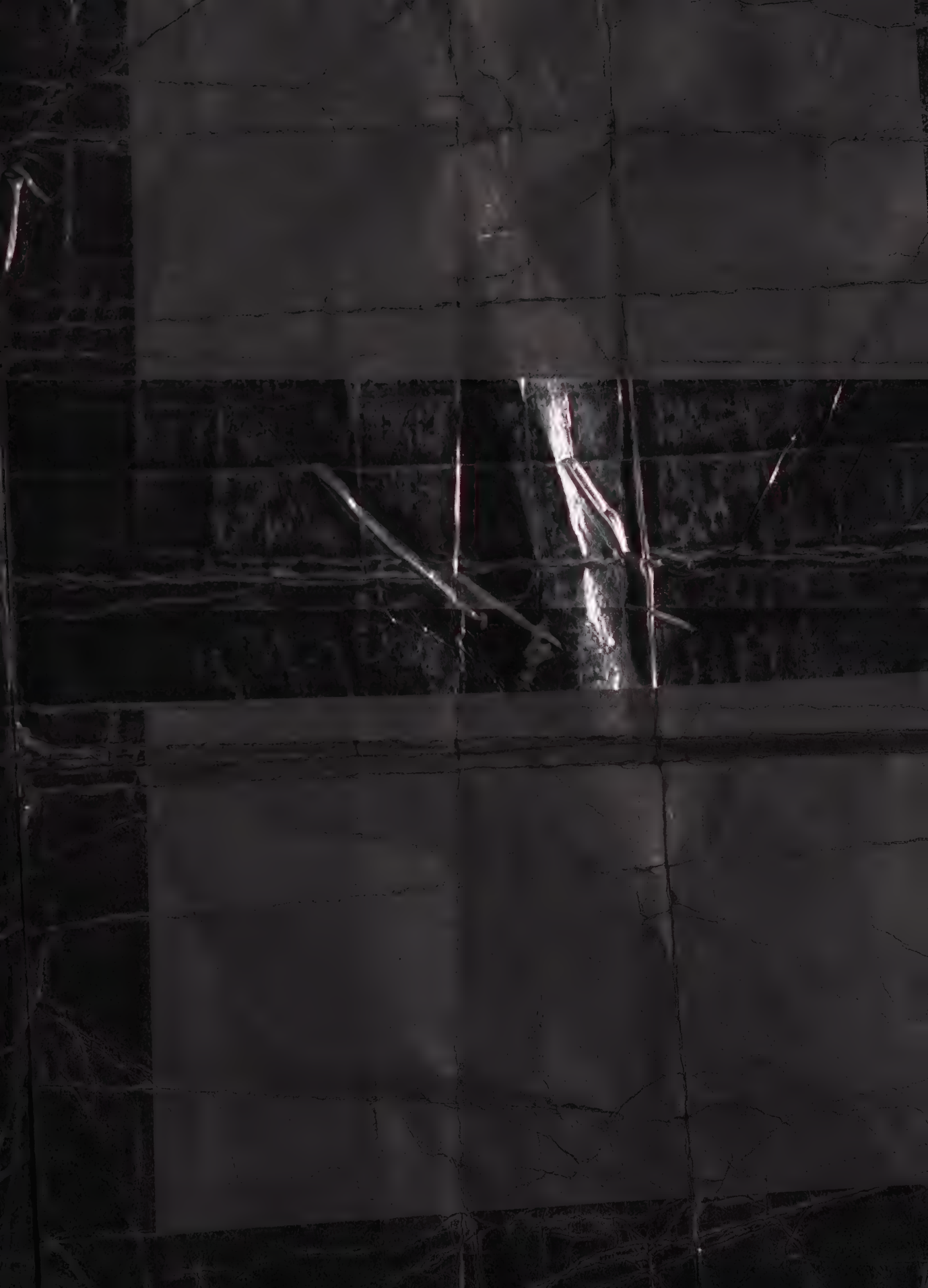
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

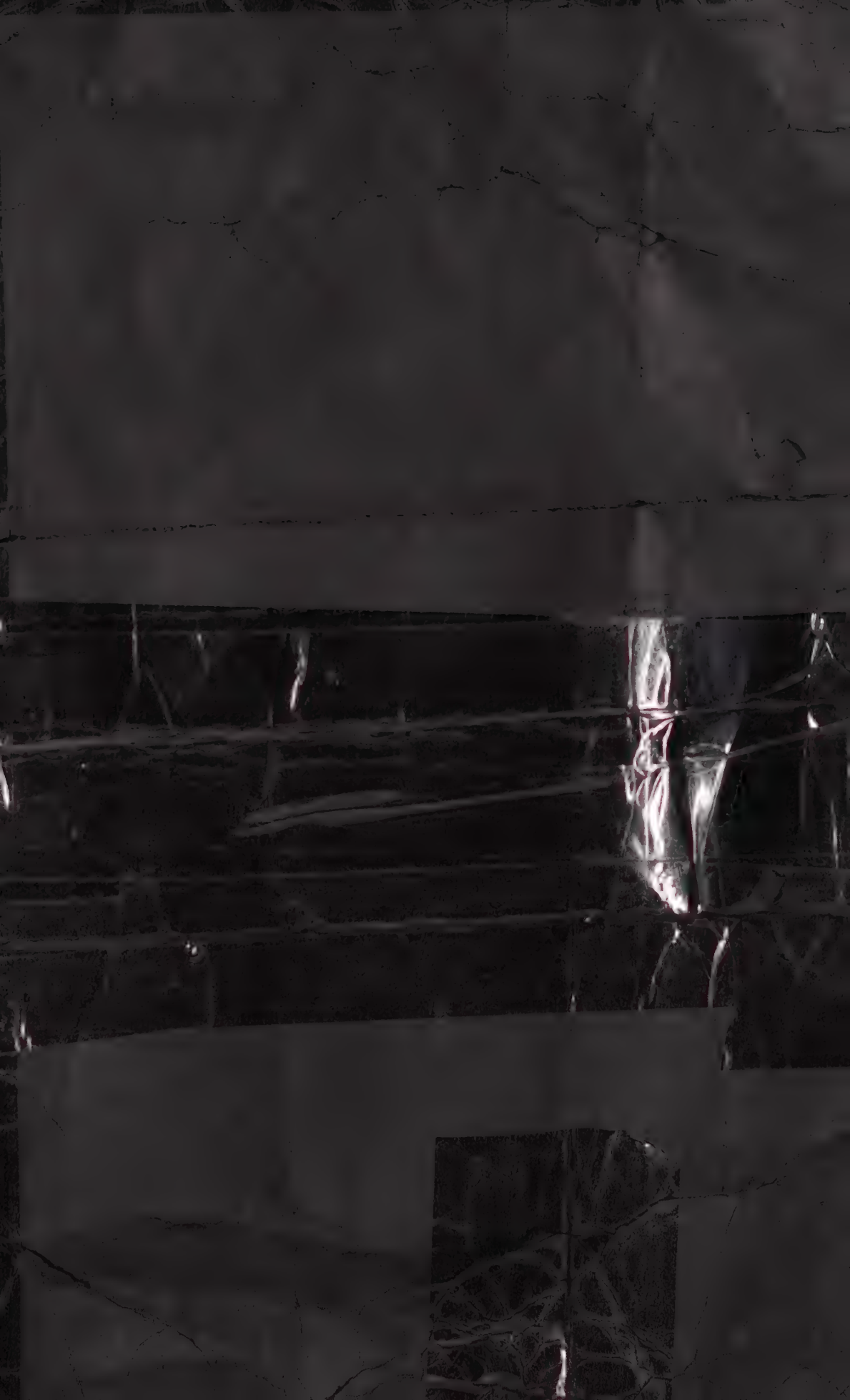
TITLE
FRONT PANEL ASS'Y.
KNOB IDENTIFICATION
NAV-750

SIZE — PART NUMBER 3-16-0105 REV B

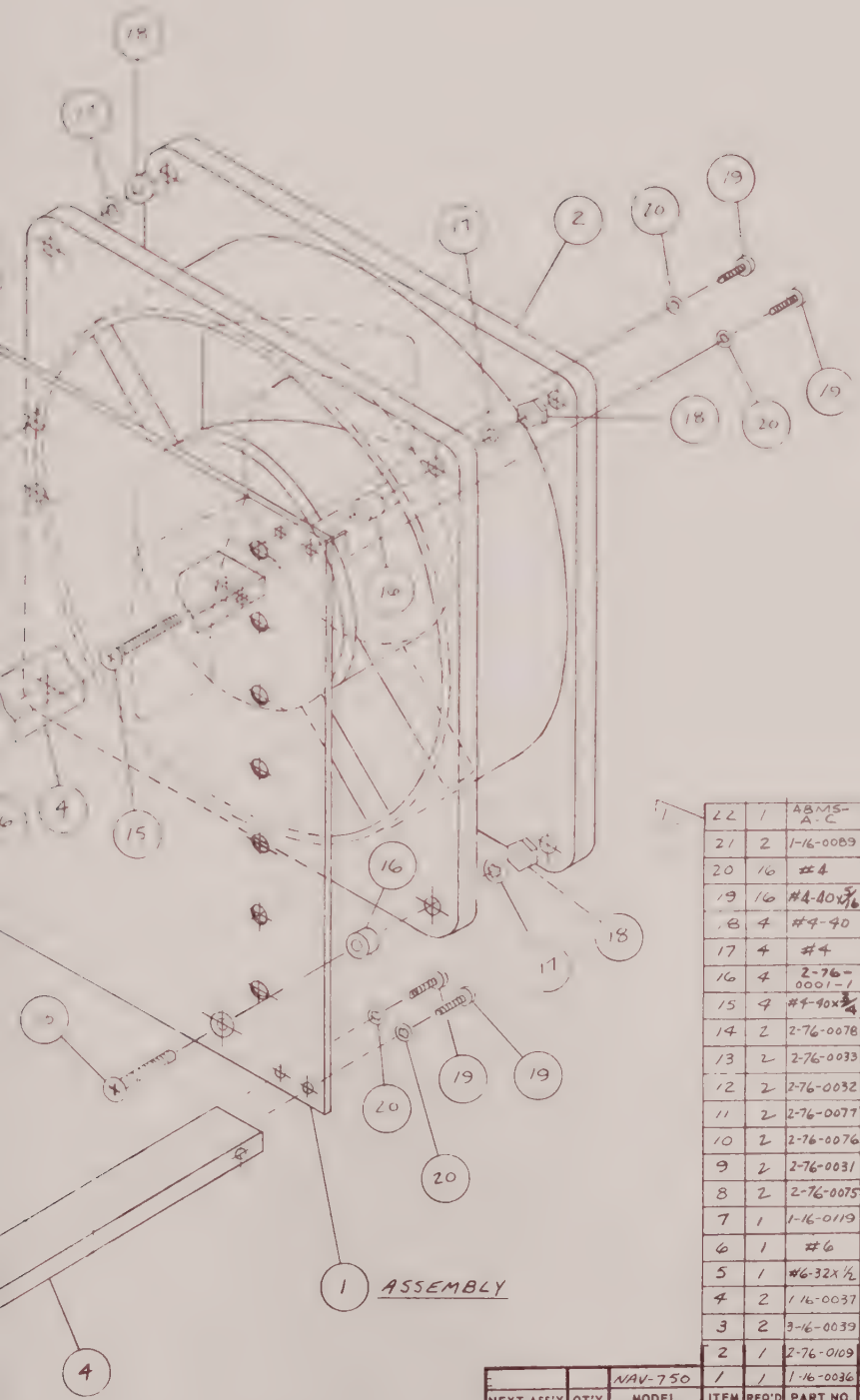
SCALE 1-1 WEIGHT — SHEET 1 OF 1


PART HAS ADHESIVE BACKING, TO BE APPLIED TO FAR SIDE OF SIDE PLATE AS SHOWN





DATE	REV	CHANGE	APP'D
11/5/75	A	INCORPORATED ECN#1 JNV	[illegible]



ITEM	REQ'D	PART NO.	DESCRIPTION
22	1	ABMS-A-C	CABLE TIE MOUNT
21	2	1-16-0089	SPACER, P.C. CARD CAGE
20	16	#4	INT. TOOTH LOCKWASHER
19	16	#4-40x5/16	PHILLIPS SCREW, BND. HD.
18	4	#4-40	NUT, LARGE PATTERN
17	4	#4	INT. TOOTH LOCKWASHER
16	4	2-76-0001-1	#4 STANDOFF, .20 LG.
15	4	#4-40x3/4	PHILLIPS SCREW, FLAT HD
14	2	2-76-0078	CARD RAIL (VIOLET)
13	2	2-76-0033	CARD RAIL (BLUE)
12	2	2-76-0032	CARD RAIL (GREEN)
11	2	2-76-0077	CARD RAIL (YELLOW)
10	2	2-76-0076	CARD RAIL (ORANGE)
9	2	2-76-0031	CARD RAIL (RED)
8	2	2-76-0075	CARD RAIL (BROWN)
7	1	1-16-0119	SIDE SUPPORT BRKT PC CARD CAGE
6	1	#6	INT. TOOTH LOCKWASHER
5	1	#6-32x1/2	PHILLIPS SCREW, BND. HD.
4	2	1-16-0037	SPACER, PC CARD CAGE
3	2	3-16-0039	SIDE PLATE, P.C. CARD CAGE
2	1	2-76-0109	FAN
1	1	1-16-0036	CARD CAGE ASS'Y

LIST OF MATERIALS

NEXT ASS'Y	QT'Y	MODEL
		NAV-750

APPLICATION

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

MATERIAL
TREATMENT
FINISH

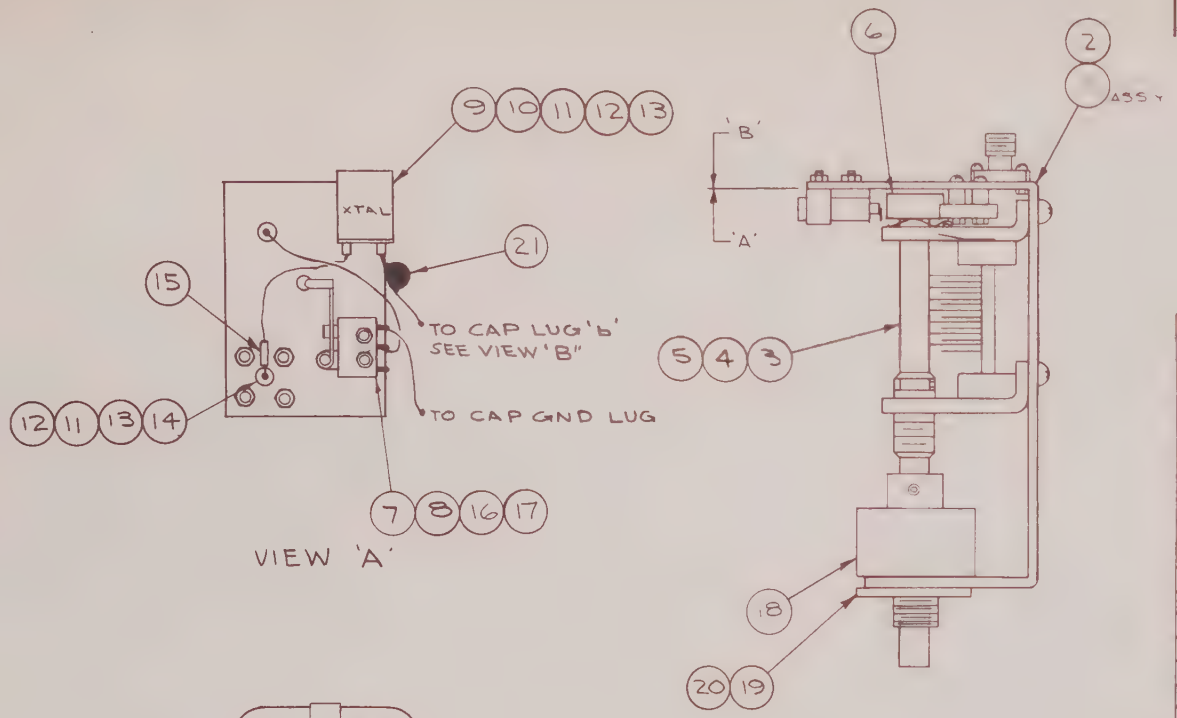
DRAWN JIG DATE 6/26/73
CHECKED [illegible] DATE 6-27-73
APPROVED [illegible] DATE 9-17-73

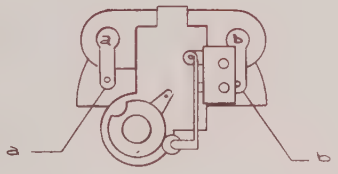
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE CARD CAGE ASS'Y NAV-750

SIZE | PART NUMBER 3-16-0036 | REV A
SCALE 1:1 | WEIGHT | SHEET 1 OF 1

FIG. 8-4





VIEW 'B'

NOTES:
1. COVER ALL BARE WIRES WITH # 22 GA TEFLON SLEEVING.
2 ALIGN NOTCH IN BUSHING TO MICRO SWITCH WHEEL WITH CAPACITOR IN FULL OPEN POSITION.

FIG. 8-5

DATE	REV	CHANGE	APP'D

ITEM	REQ'D	PART NO.	DESCRIPTION
21	1	5GA047	SPRAGUE 47PF DISC. CAP
20	3	#4-40X1/4	PHIL. SCREW, FLAT HEAD
9	1	76-0197	PLANETARY DRIVE ADAPTOR
8	1	76-0144	PLANETARY DRIVE
—	AS REQ'D	22GA.	TEFLON SLEEVE
—	AS REQ'D	22GA.	BUSS WIRE
17	2	#2-56X1/2	PHIL SCREW, BND. HD.
16	2	76-0001-2	SPACER
15	1	1025-48	SUH CHOKE
14	1	76-0053-2	MODIFIED CONNECTOR
13	6	#2	INT TOOTH LOCKWASHER
12	6	#2-56	HEX NUT, SMALL PAT.
11	6	#2-56X1/4	PHIL. SCREW, BND HD.
10	1	800B-G3	CRYSTAL HOLDER
9	1	0063-22	10.0065 MHz CRYSTAL
8	1	MX-25	MICRO SWITCH, MTG. KIT
7	1	115X21-T	MICRO SWITCH
6	1	16-0090	BUSHING, MICRO SW.
5	2	#6	INT. TOOTH LOCKWASHER
4	2	#632X1/4	PHIL. SCREW, BND HD.
3	1	76-0143	TUNING CAPACITOR
2	1	16-0198	MTG. BRKT, DELTA "F"
1	1	16-0205	ASSEMBLY

NEXT ASS'Y	QT'Y	MODEL
	1	NAV-750

APPLICATION

LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .008
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 √
REMOVE ALL BURRS

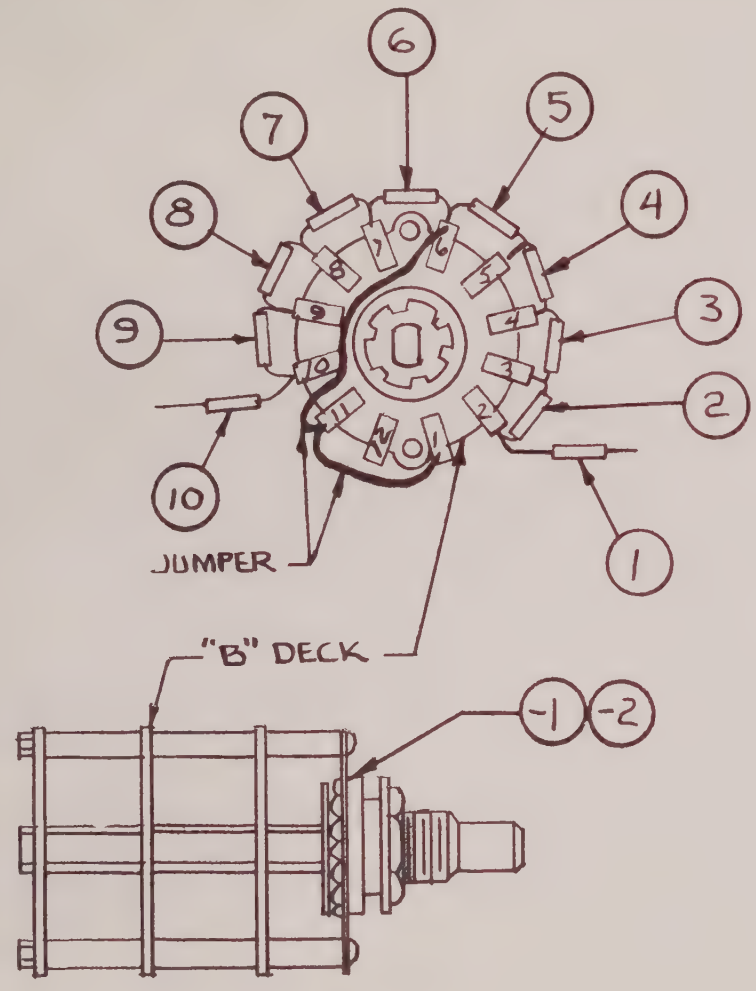
DRAWN JNV 1/14/74
CHECKED MHL 1-14-73
APPROVED WE 1-15-74

MATERIAL ASSEMBLY
TREATMENT
FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE
DELTA "F"
TUNING CAPACITOR
ASS'Y

SIZE B | PART NUMBER 2-16-0205 | REV
SCALE 1:1 | WEIGHT —
SHEET 1 OF 1



NAV-750		NAV-750A	
WITH 1% RES.		WITH .01% RES.	
RES. NO	VALUE	RES. NO	VALUE
1	10K	1	2.5K
2	2.26K	2	562.5Ω
3	3.09K	3	775Ω
4	2.32K	4	587.5Ω
5	2.32K	5	575Ω
6	2.32K	6	575Ω
7	2.32K	7	587.5Ω
8	3.09K	8	775Ω
9	2.26K	9	562.5Ω
10	10K	10	2.5K
1-16-0126-1		1-16-0126-2	

REQ'D	PART NO.	DESCRIPTION
A/R	26 GA.	TEFLON SLEEVING
A/R	26 GA	BUSS WIRE
NOTED	5102	"VISHAY" .01% 1/4W RES.
NOTED	NA-55D-1	"CORNING" 1% 1/4W RES.
1/1	1-26-0116	MODIFIED "CENTRALAB" SWITCH

INSTRUMENT FLIGHT RESEARCH CORP.
4053 Navajo Lane
Wichita, Ks.

LOCALIZER SWITCH WIRING NAV-750 & NAV-750 A

DWN	DATE 1/29/75
CHKD	DATE 2-21-75
APP	DATE 2-21-75
DWN	
APP	

PART NO 1-16-0126-1&-2 REV B DATE 1-29-75

SCALE ——— MODEL NAV-750 SHT. 1 of 1

FIG. 8-6

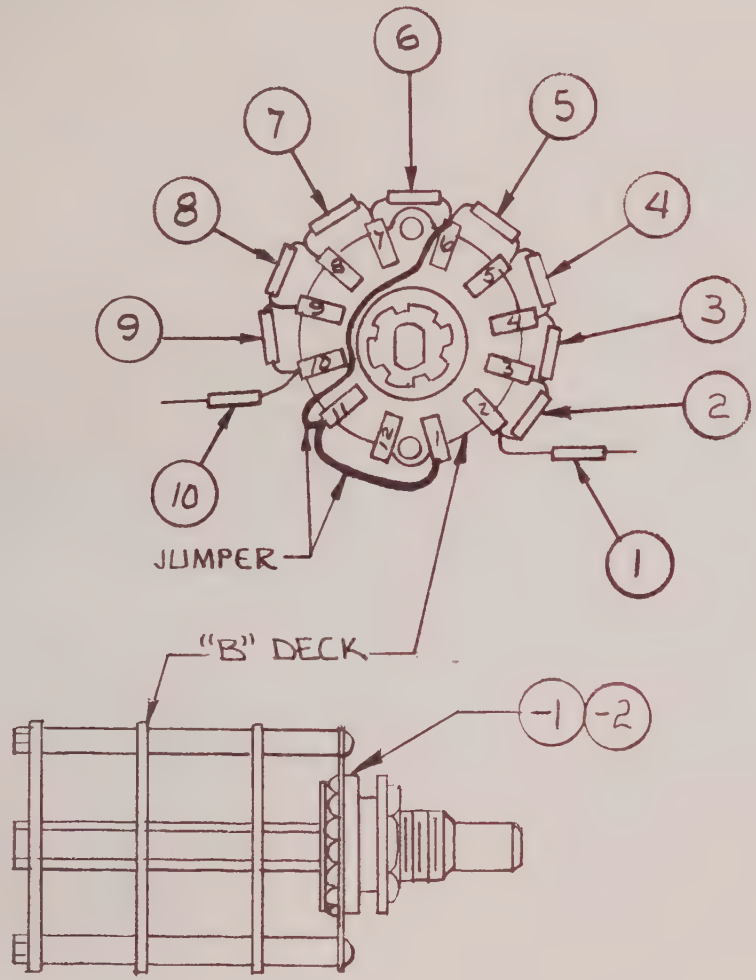


FIG. 8-7

NAV-750 WITH 1% RES.		NAV-750A WITH .01% RES.	
RES. NO.	VALUE	RES. NO.	VALUE
1	20K	1	2.5K
2	11.3K	2	1.40625K
3	4.22K	3	525Ω
4	2.26K	4	287.5Ω
5	2.26K	5	281.25Ω
6	2.26K	6	281.25Ω
7	2.26K	7	287.5Ω
8	4.22K	8	525Ω
9	11.3K	9	1.40625K
10	20K	10	2.5K
1-16-0127-1		1-16-0127-2	

REQ'D	PART NO.	DESCRIPTION
A/R	26 GA.	TEFLON SLEEVING
A/R	26 GA.	BUS WIRE
NOTED	5102	"VISHAY" .01% 1/4W RES.
NOTED	NA-55D-1	"CORNING" 1% 1/4W RES.
1/1	1-76-0116	MODIFIED "CENTRALAB" SWITCH

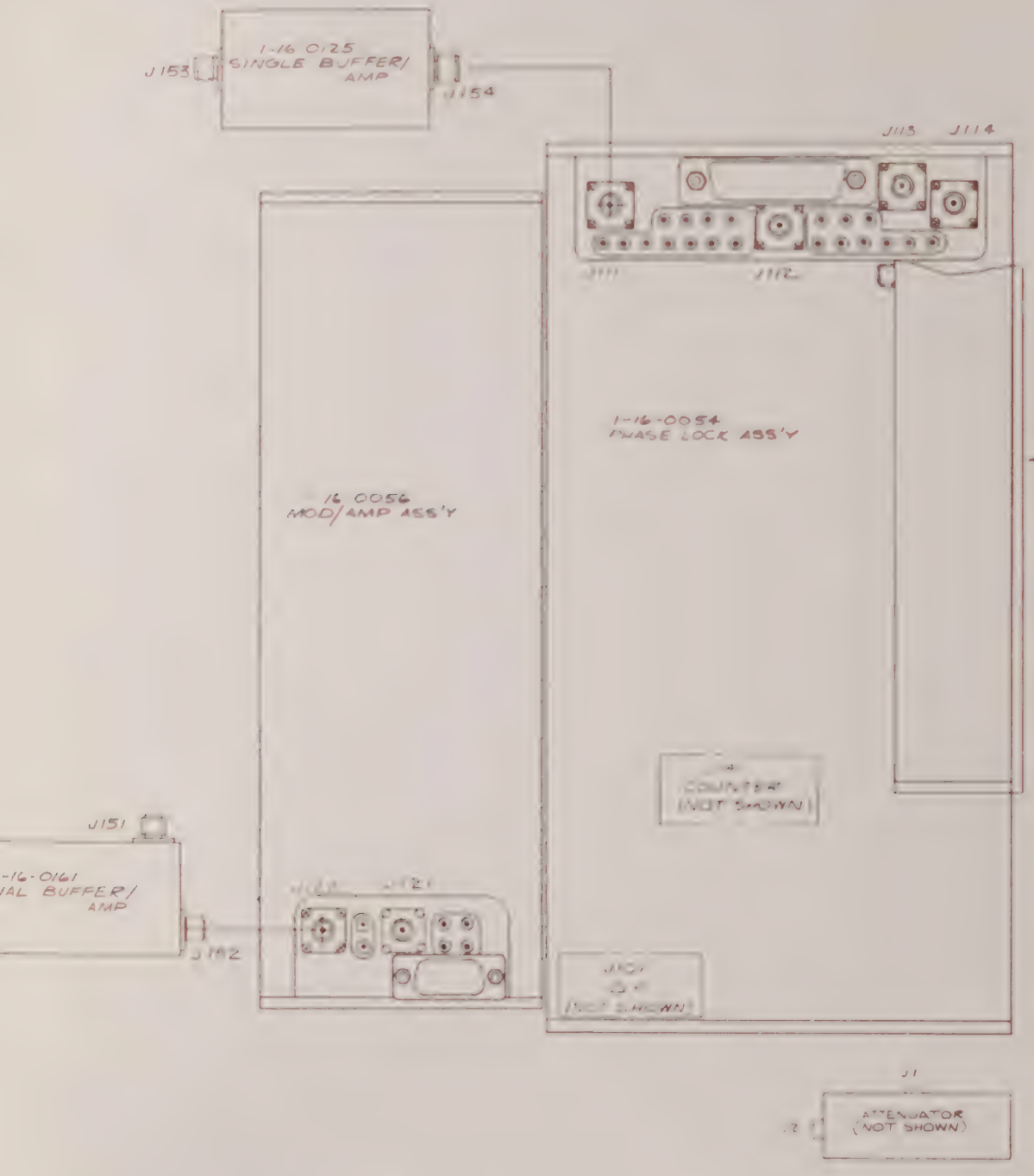
INSTRUMENT FLIGHT RESEARCH CORP.
4053 Navajo Lane
Wichita, Ks.

DWN B DATE 1/29/75
CHKD DATE 2-21-75
APP DATE 2-21-75

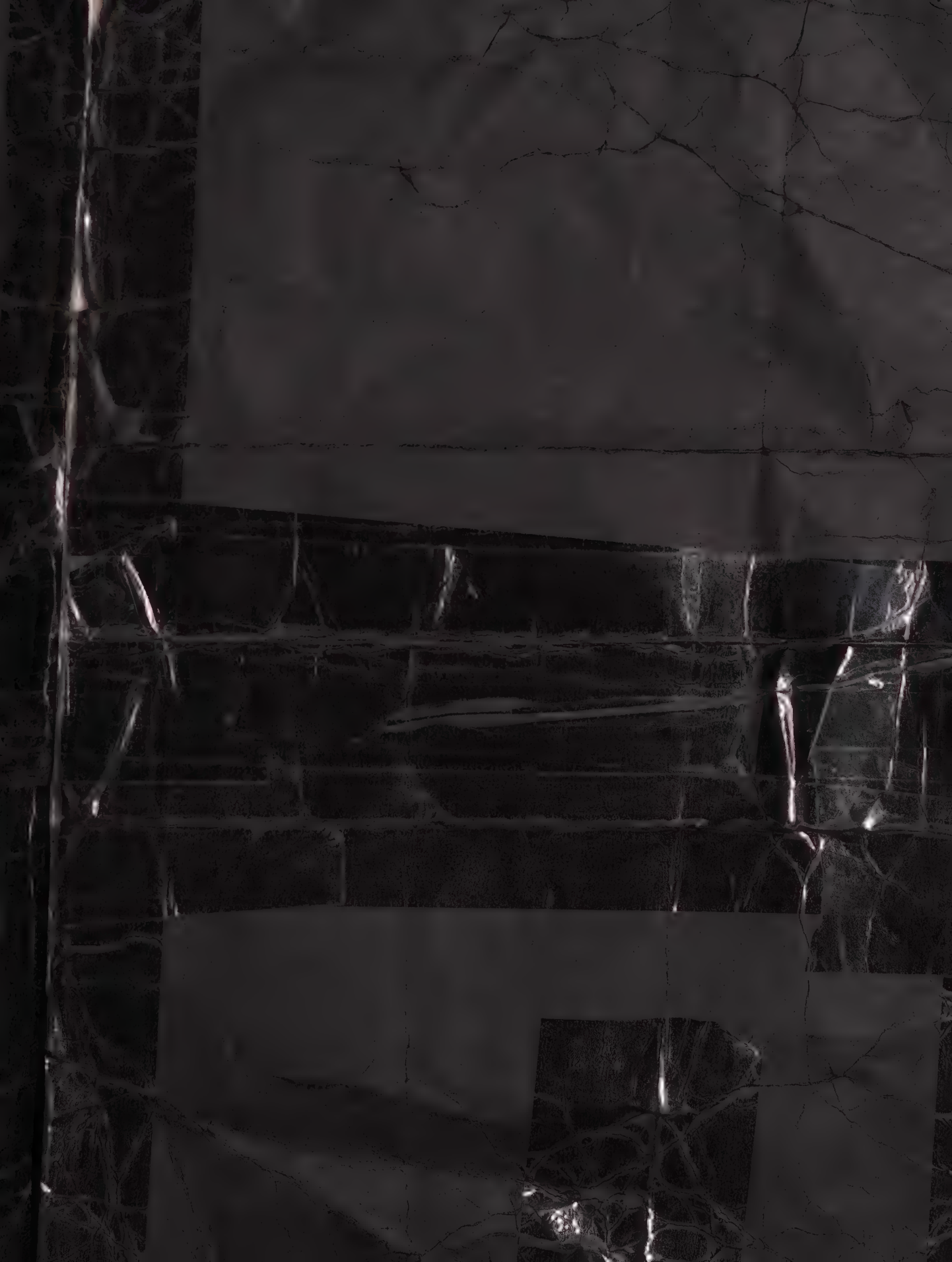
GLIDE SLOPE SWITCH WIRING NAV-750 & NAV-750A

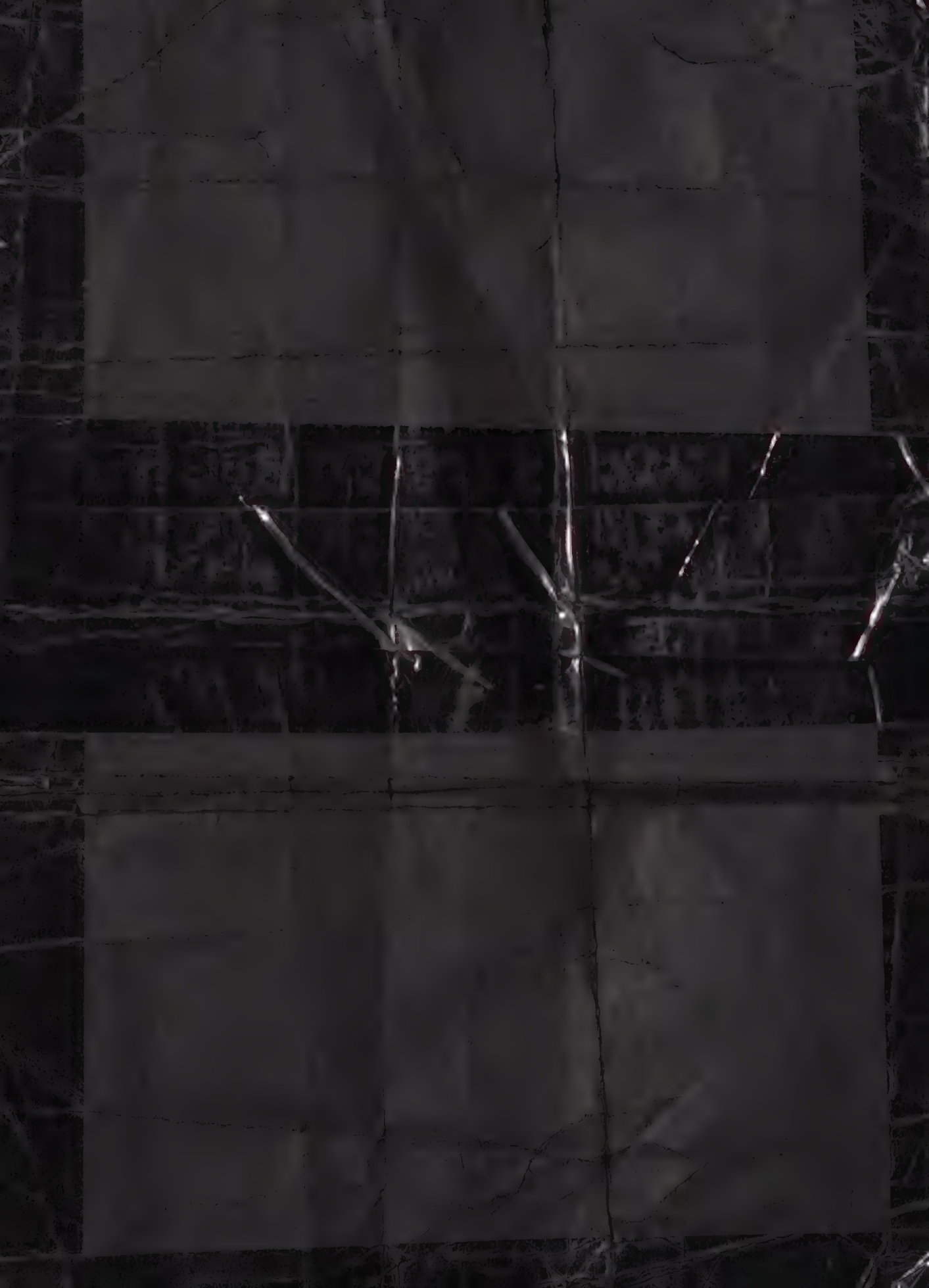
PART NO 1-16-0127-1&-2 REV D DATE 1-29-75 DWN APP

SCALE —— MODEL NAV-750 SHT. 1 of 1



COAX CHART		
P/N	FROM	TO
3-16-0133	J121	
2-16-0134	J124	J101
3-16-0136	J131	J151
2-160137	J111	J154
2-16-0138	J112	J132
2-16-0145	J113	J141
2-16-0135	J2	J3





DATE	REV	CHANGE	APP'D

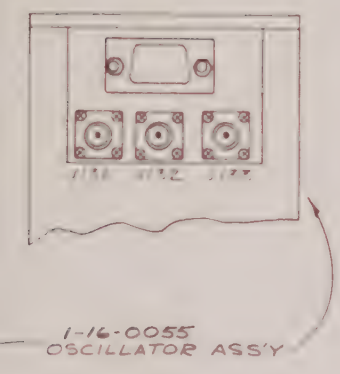


FIG. 8-8

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
	1	NAV-750	—	—	16-0163	RF FLOOR- COAX ASS'Y

APPLICATION — LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 J
REMOVE ALL BURRS

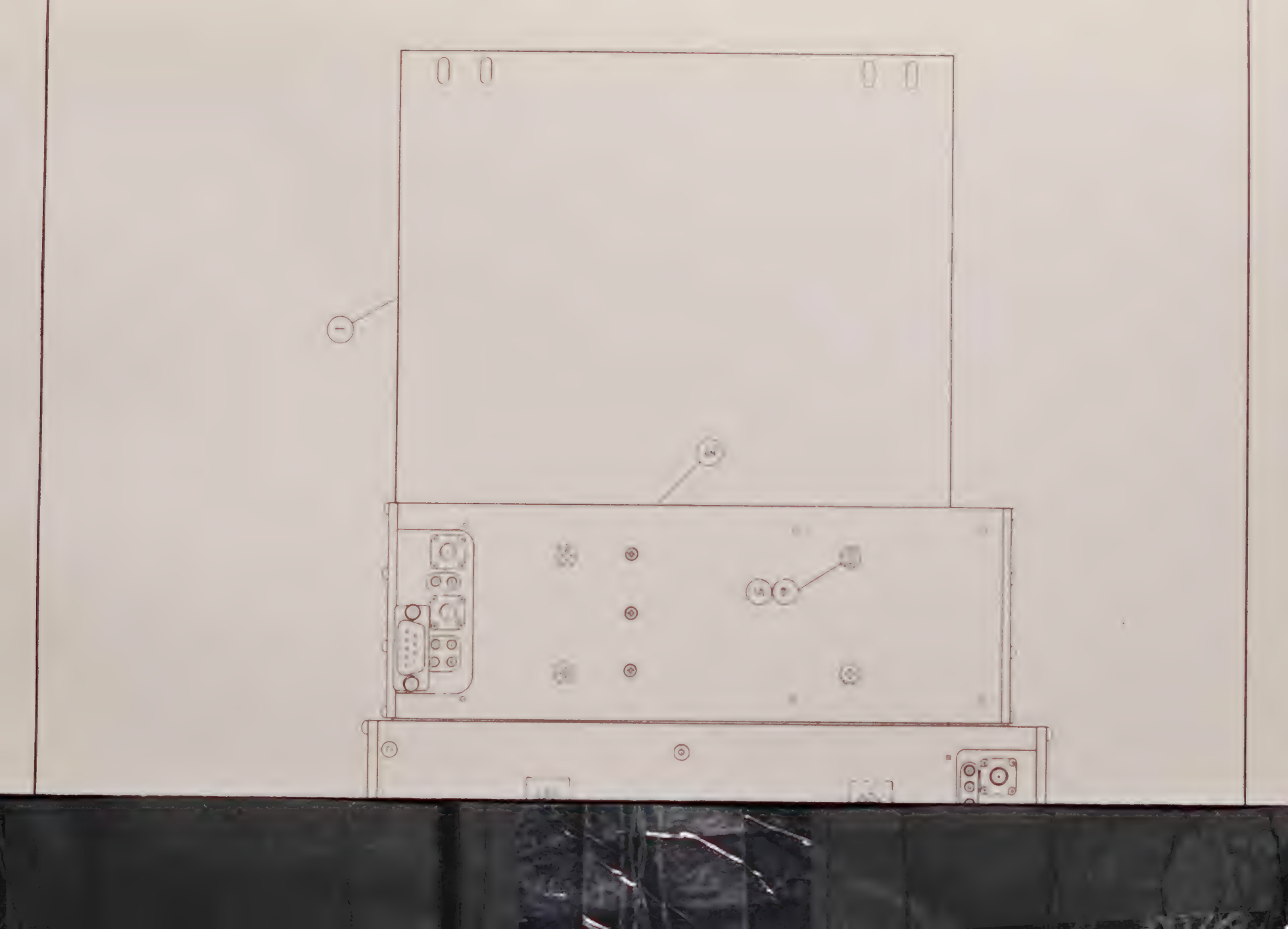
DRAWN JNV DATE 9/25/73
CHECKED MHL DATE 9-25-73
APPROVED DATE 9-25-73

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE
RF FLOOR - COAX ASS'Y
CONNECTION DIAGRAM
NAV-750

MATERIAL ASSEMBLY
TREATMENT
FINISH

SIZE | PART NUMBER 3-16-0163 | REV
SCALE 1:1 | WEIGHT | SHEET 1 OF 1



DATE	REV	CHANGE	APP'D

FIG. 8-9

ITEM	REQ'D	PART NO.	DESCRIPTION
6	8	#6-32X 5/16	PHILLIPS SCREW, BND. HD.
5	8	#6	LOCKWASHER, INT TOOTH
4	2	1-16-0086	SPACER, PHASE LOCK ASS'Y
3	1	1-16-0056	MODULATOR/AMP. ASS'Y
2	1	1-16-0054	PHASE LOCK ASS'Y
1	1	1-16-0053	FLOOR ASS'Y

P/LIST | 1 | NAV 750
NEXT ASS'Y | QT'Y | MODEL

APPLICATION

LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .006
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN DATE: TM 5/14/73
CHECKED DATE: RE 1-17-73
APPROVED DATE: W.B. 2-18-73

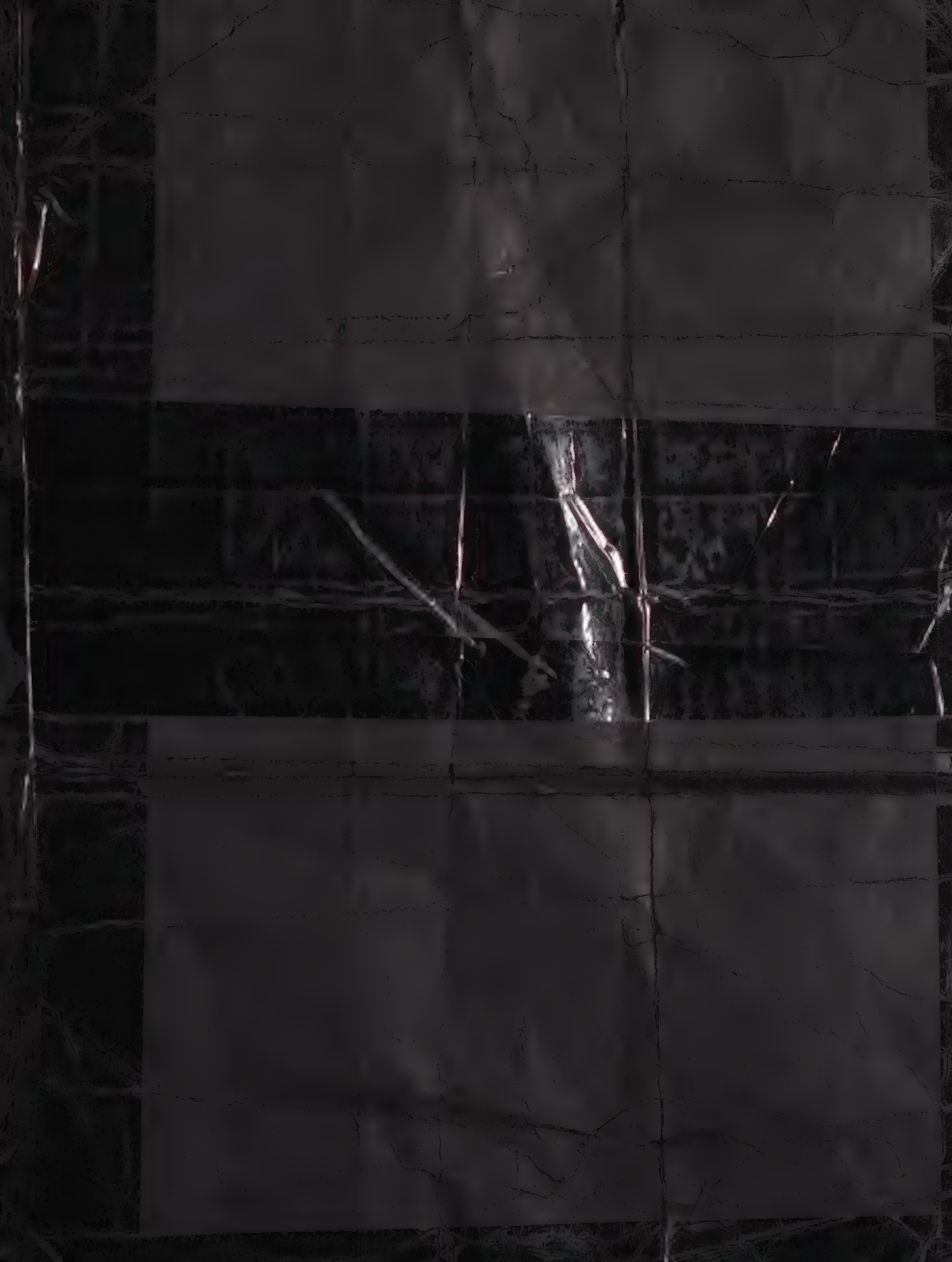
MATERIAL: SEE DESCRIPTION
TREATMENT:
FINISH:

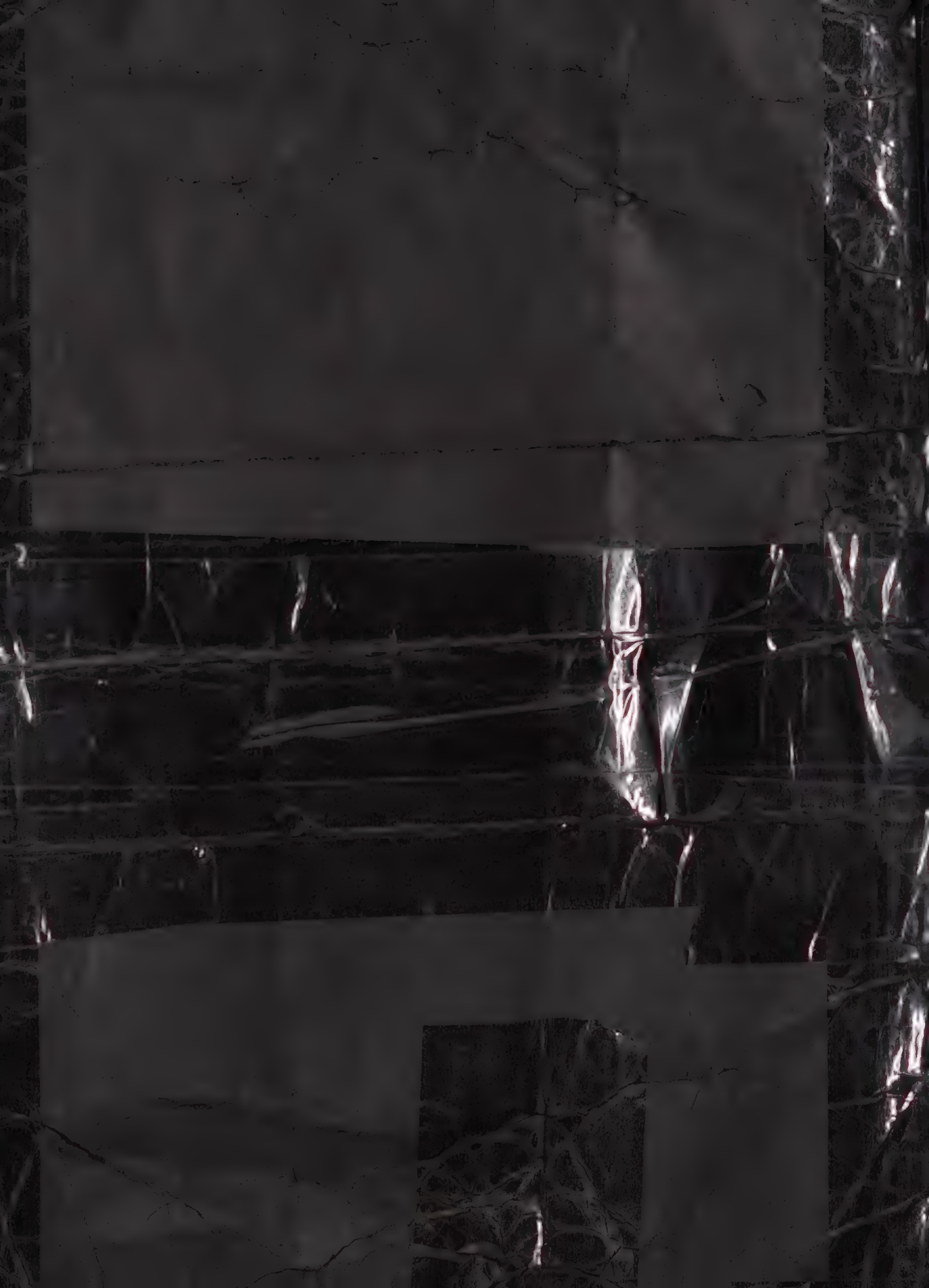
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: FLOOR ASSEMBLY NAV-750

SIZE: C | PART NUMBER: 3-16-0053 | REV:
SCALE: 1 : 1 | WEIGHT: | SHEET 1 OF 1

9
5
6
10
11
4
2
3
7
5
6
26
28
14





DATE	REV	CHANGE	APP'D

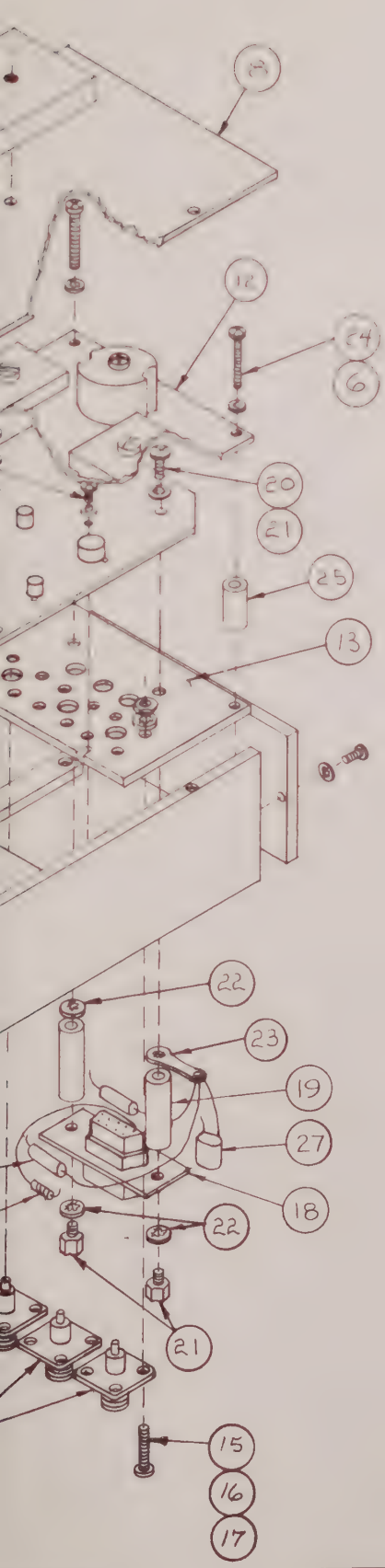


FIG. 8-10

ITEM	REQ'D	PART NO.	DESCRIPTION
28	1	1025-28	2.2μH CHOKE
27	1	K47C35	47μf 35V TANT. CAP.
26	2	NORBD35	6.8μf 35V TANT CAP.
25	2	2-76-0001-60	SPACER
24	2	#2-56 x 3/4	PHIL. BIND HD. MACH SCW.
23	1	1411-4	"H & H SMITH" GND LUG.
22	3	#4	INT. TOOTH L.W.
21	2	1-76-0013	SHELL NUT
20	2	#4-40 x 1/2	PHIL. BIND HD. MACH. SCW.
19	2	2-76-0001-38	SPACER
18	1	205204-1	"AMP" 9 PIN MALE CONN.
17	12	#2	INT. TOOTH L.W.
16	12	#2-56	SMALL PATTERN HEX NUT
15	12	#2-56 x 3/8	PHIL. BIND. HD. MACH. SCW.
14	3	1-76-0101	"AMERICON" CONN.
13	1	1-16-0062	SHIELD PLATE
12	1	1-16-0208	OSC. Aff. BD. 12.5KHz & LOCK SYSTEM
11	3	#6	INT. TOOTH L.W.
10	3	#6-32 x 5/16	PHIL. BIND HD. MACH. SCW.
9	1	1-16-0088	SPACER
8	1	2-16-0069	COVER
7	2	1-16-0063	END PLATE
6	22	#2	INT. TOOTH L.W.
5	22	#2-56 x 5/16	PHIL. BIND HD. MACH. SCW.
4	1	1-16-0096	OSC. PC. BD. ASS'Y.
3	4	850-31[illegible]-11-07	"CAMBION" SPACER
2	1	2-16-0061	OSC. HOUSING BLOCK
1	1	1-16-0055	OSCILLATOR ASS'Y.

NEXT ASS'Y	QT'Y	MODEL
	1	NAV-750

APPLICATION

LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS .XX = ± .010 .XXX = ± .005
ANGLES ± 1/2°
FRACTIONS ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

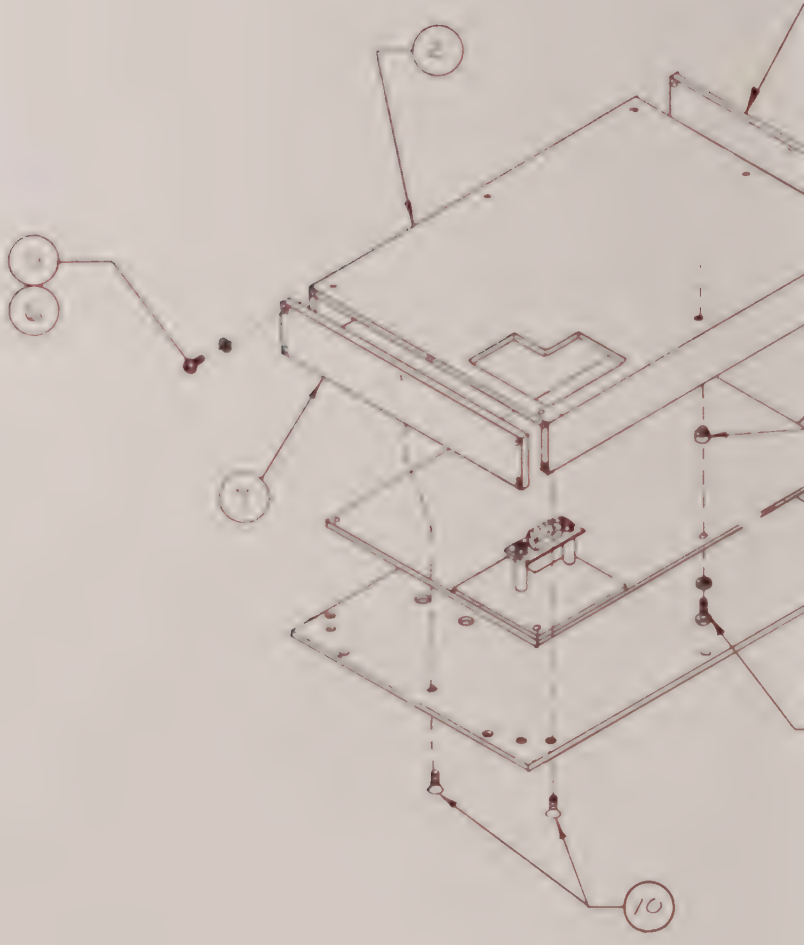
	DRAWN	DATE
	[illegible]	1-24-75
CHECKED		DATE
[illegible]		2-17-75
APPROVED		DATE
[illegible]		2-19-75

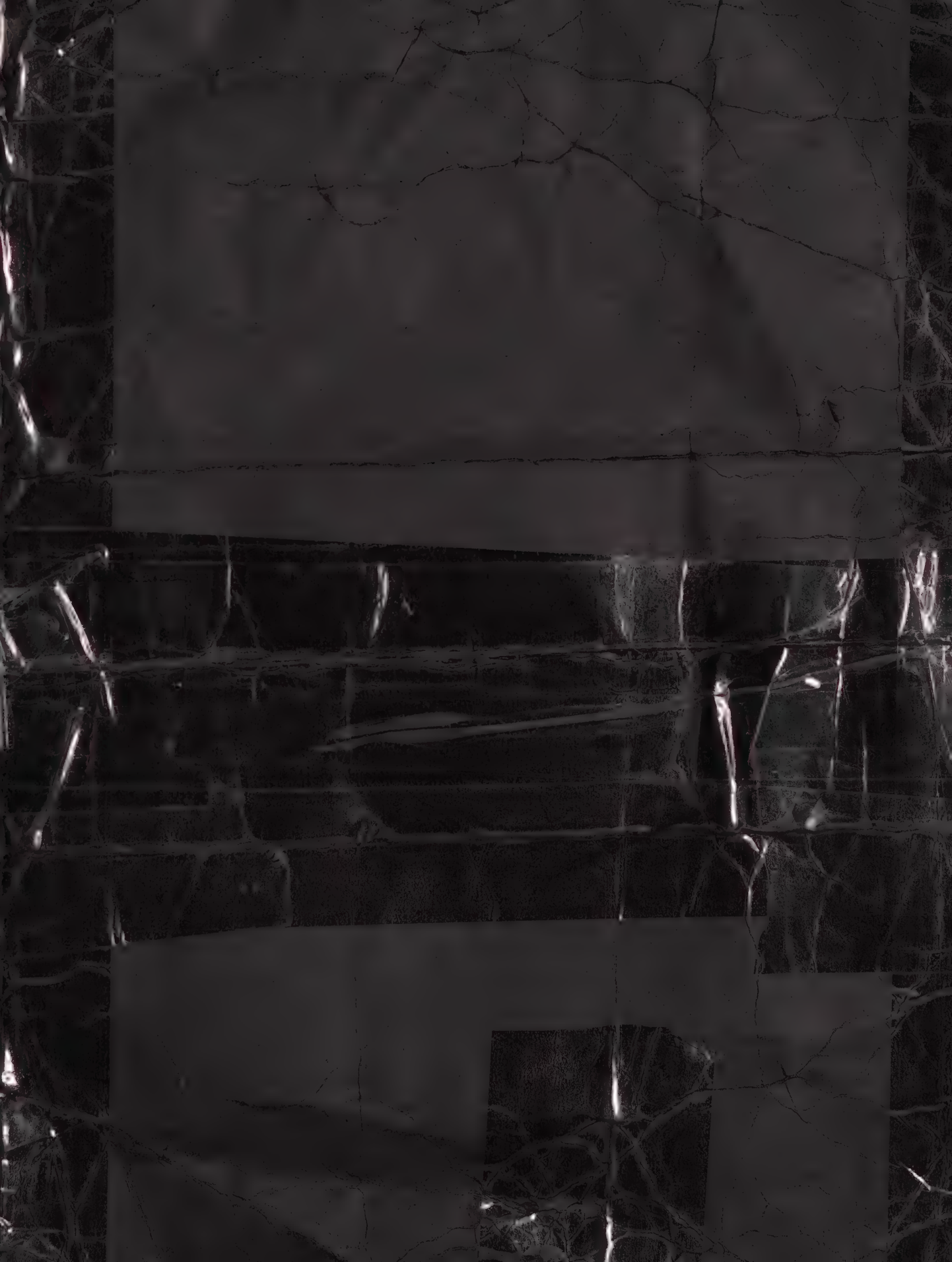
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

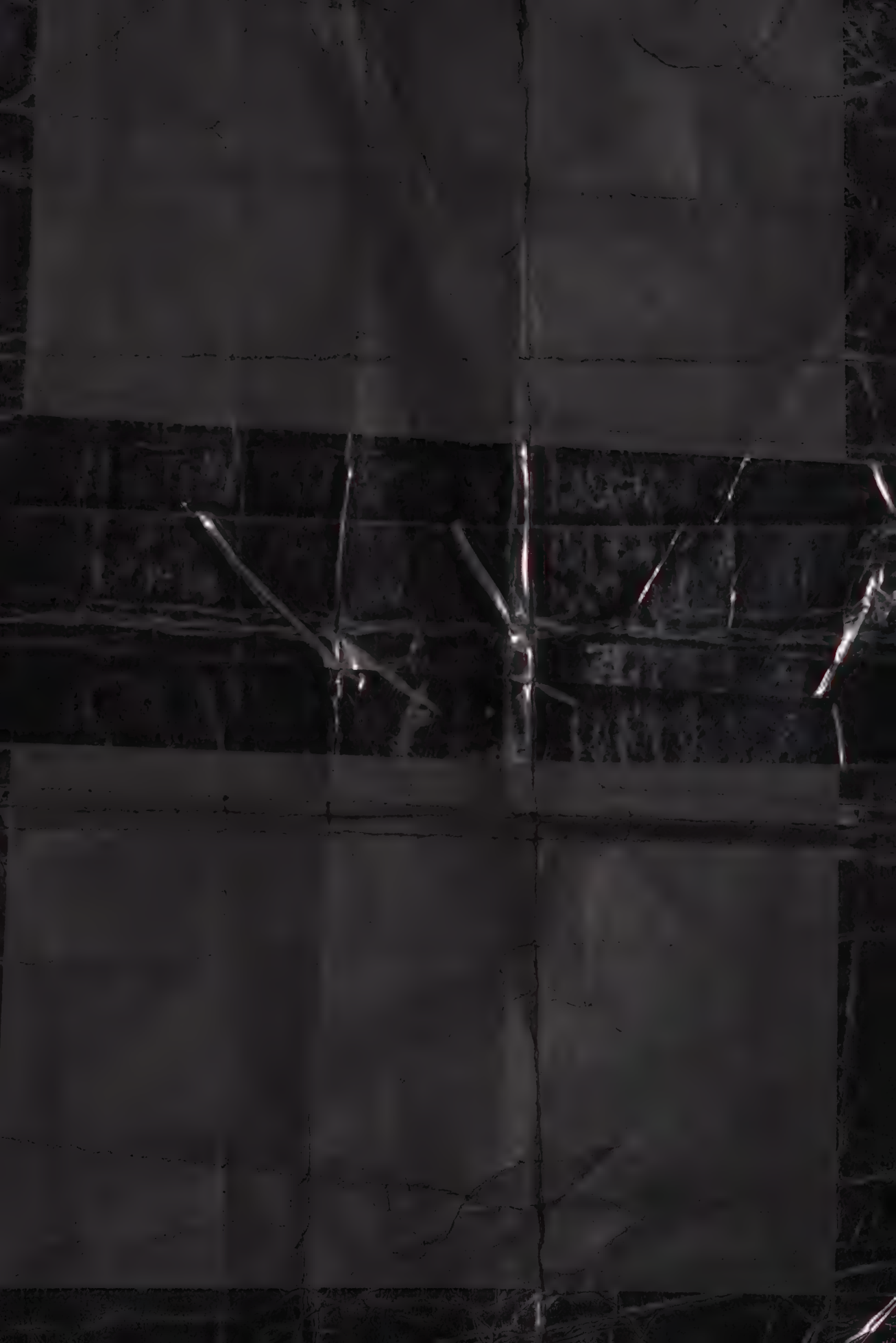
TITLE: OSC. ASS'Y. NAV-750 (PHYSICAL)

MATERIAL: NOTED
TREATMENT:
FINISH:

SIZE: — | PART NUMBER: 3-16-0055 | REV:
SCALE: NONE | WEIGHT: — | SHEET 1 OF 1


2
1
6
7
10





DATE	REV	CHANGE	APP'D

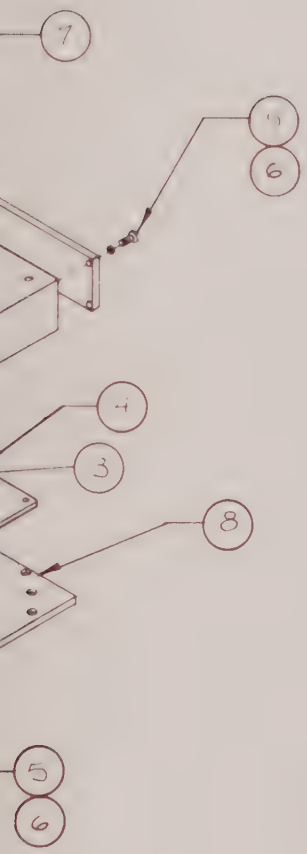


FIG. 8-10A

10	12	#2-56 x 1/4	PHILLIPS FLAT HD MACH SCW.
9	10	#2-56 x 3/16	PHILLIPS BIND HD MACH. SCW.
8	1	2-16-0181	COVER
7	2	1-16-0182	END PLATE
6	17	# 2	INT. TOOTH L.W.
5	7	#2-56 x 3/8	PHIL. BIND HD, MACH, SCW.
4	1	1-16-0184	8 STEP OSC. PC. B.D ASS'Y.
3	6	350-2198-33-07	"CAMBION" SPACER
2	1	3-16-0180	OSC. HOUSING
1	1	1-16-0187	8 STEP OSCILLATOR
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
	1	NAV-750				

APPLICATION — LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

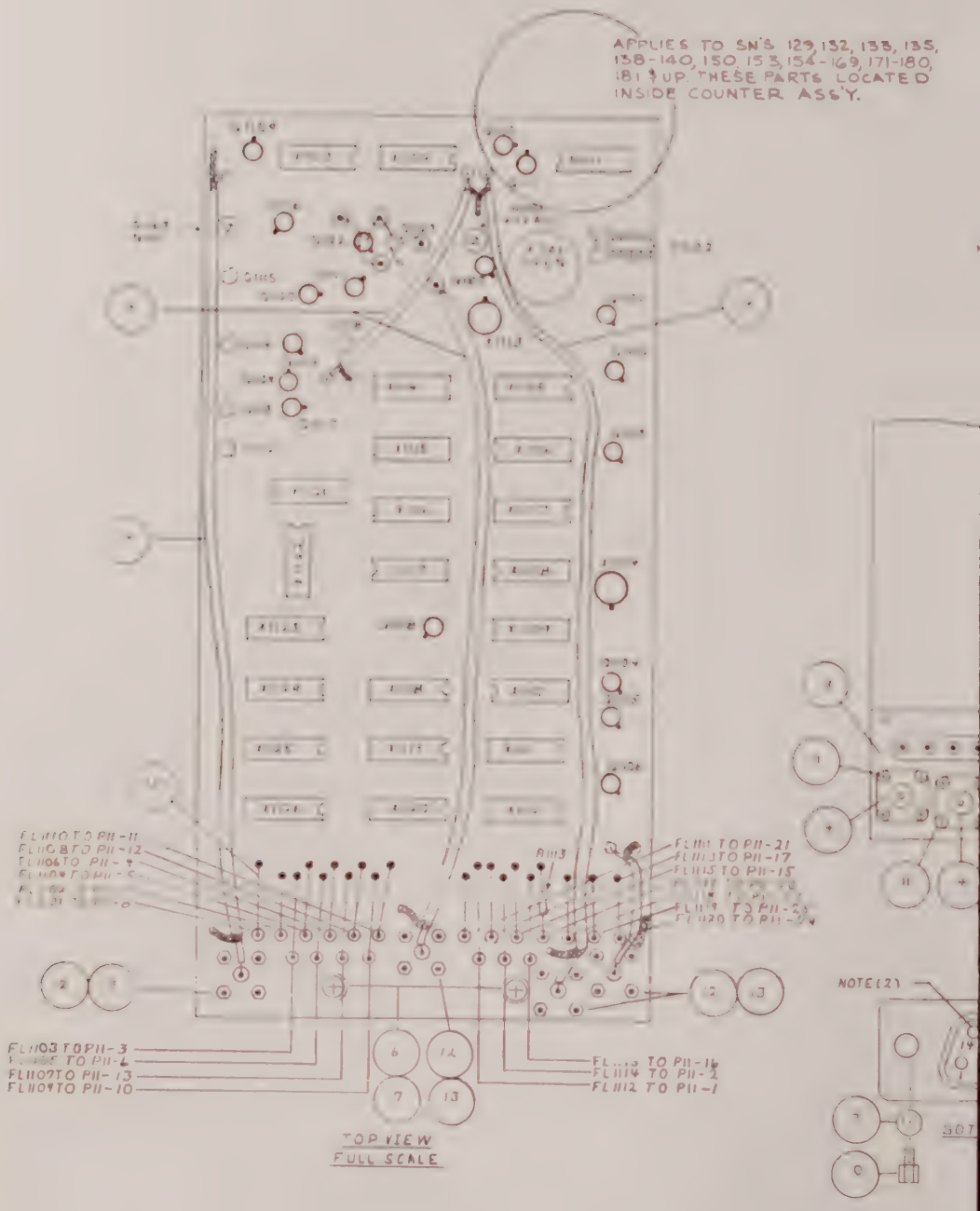
DRAWN DATE 1-20-75
CHECKED DATE 1-18-75
APPROVED DATE 1-18-75

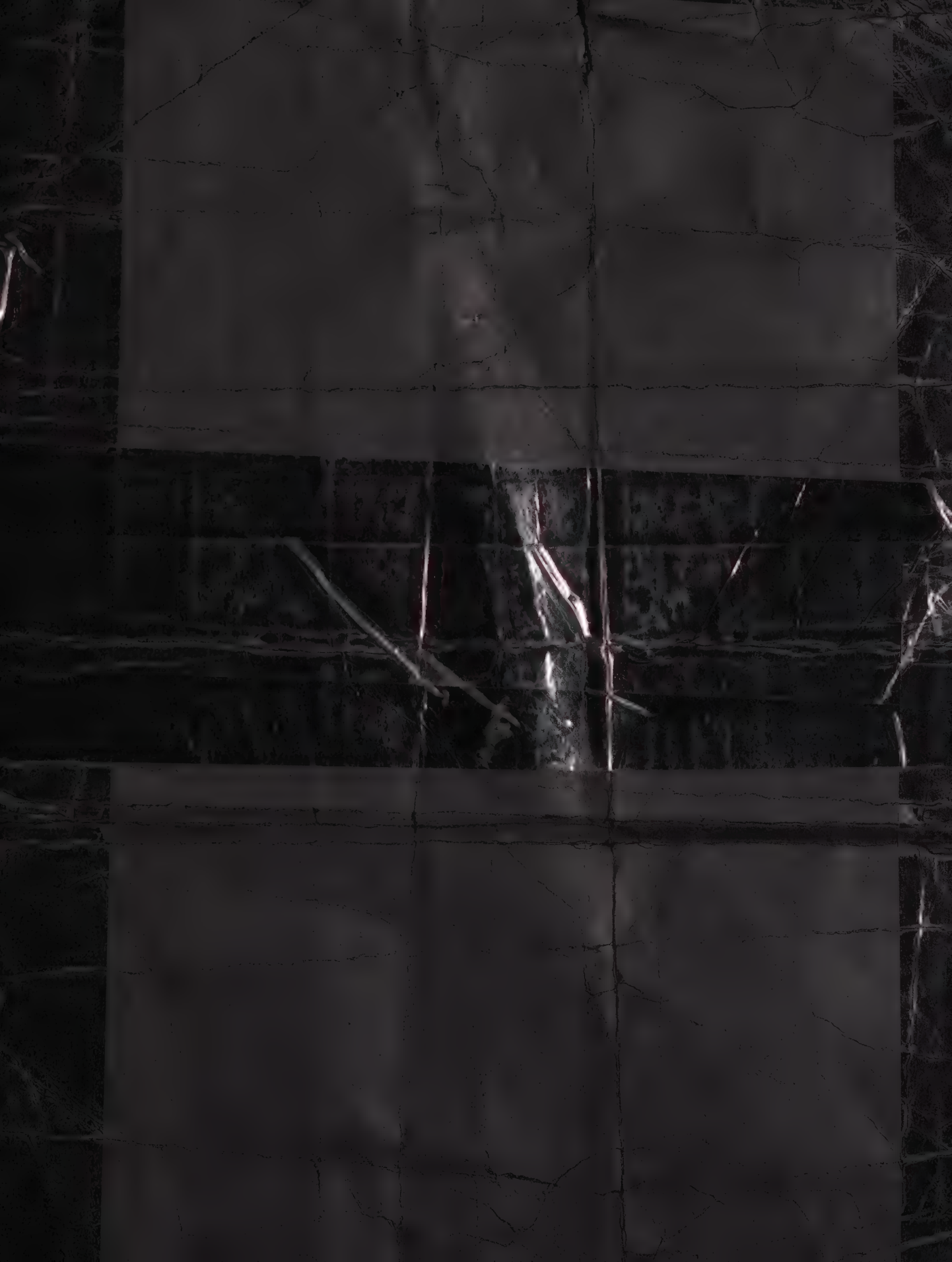
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

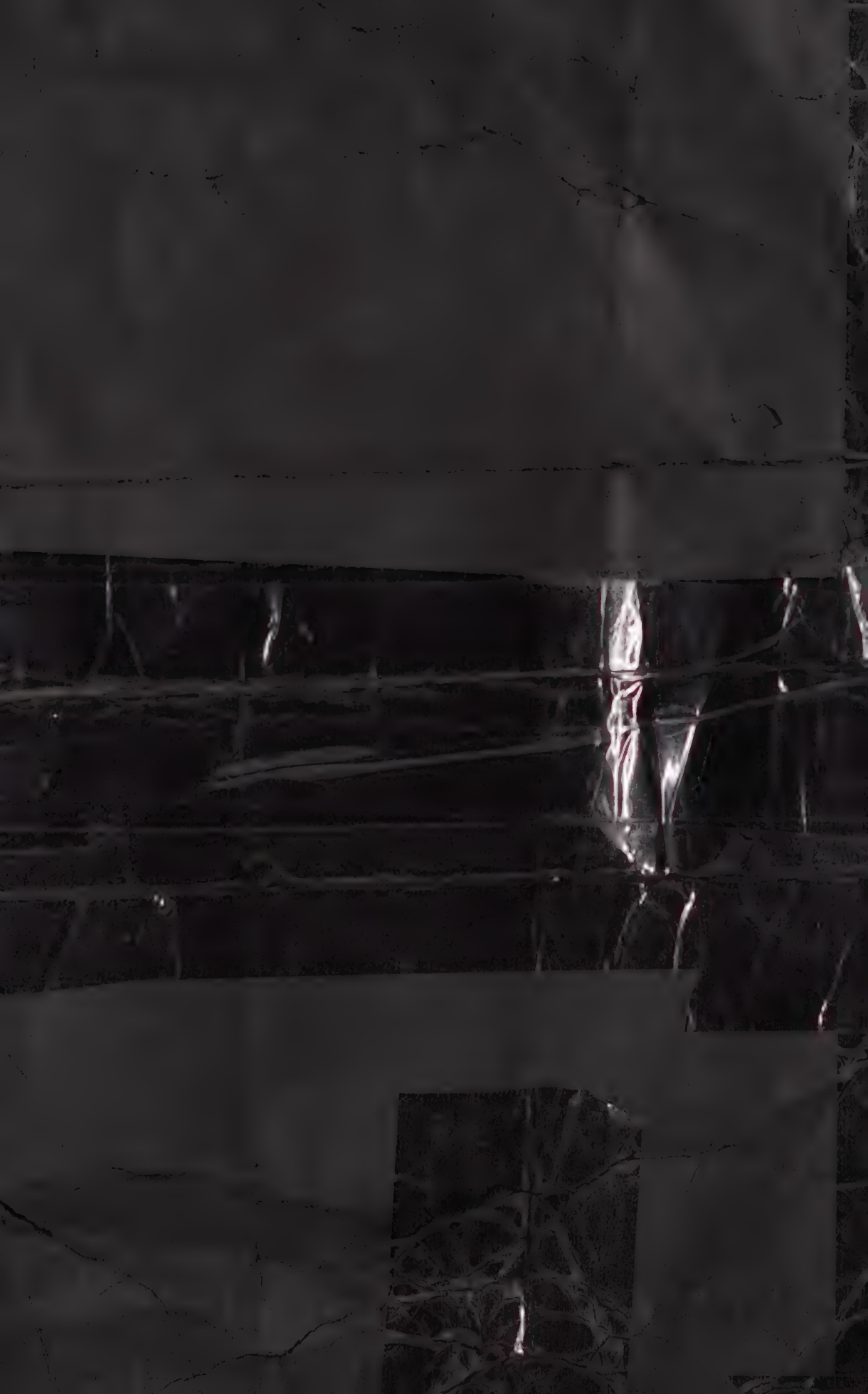
TITLE: 8 STEP OSCILLATOR ASS'Y. PHYSICAL

MATERIAL: NOTED
TREATMENT:
FINISH:

SIZE | PART NUMBER: 3-16-0187 | REV
SCALE: NONE | WEIGHT | SHEET 1 OF 1

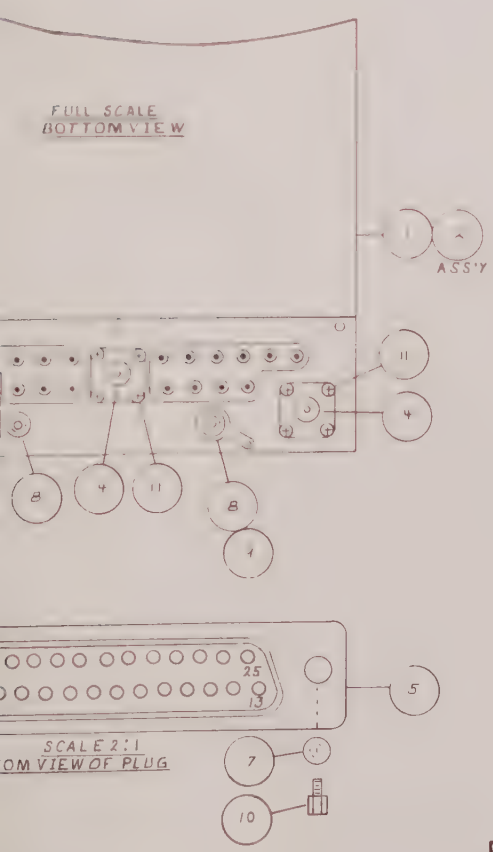

APPLIES TO SN'S 129, 132, 133, 135, 138-140, 150, 153, 154-169, 171-180, 181 & UP. THESE PARTS LOCATED INSIDE COUNTER ASS'Y.
FL1101 TO P11-11
FL1108 TO P11-12
FL1106 TO P11-9
FL1104 TO P11-6
FL1103 TO P11-3
FL1105 TO P11-4
FL1102 TO P11-13
FL1107 TO P11-10
FL1111 TO P11-21
FL1113 TO P11-17
FL1115 TO P11-15
FL1119 TO P11-23
FL1120 TO P11-24
FL1116 TO P11-16
FL1114 TO P11-2
FL1112 TO P11-1
NOTE (2)
TOP VIEW
FULL SCALE





DATE	REV	CHANGE	APP'D

OTES:
PII - 22 IS SYSTEM GROUND
PII - 4 (RED) IS +12V TO BUFFER AMP.
LEAVE WIRE APPROX. 5'0" LONG.



SCALE 2:1
OM VIEW OF PLUG

FIG. 8-11

ITEM	REQ'D	PART NO.	DESCRIPTION
15	AS REQ'D	#22GA	INSOL. WIRE
14	AS REQ'D	RG-188	COAXIAL CABLE
13	12	# 2	INT TOOTH LOCKWASHER
12	12	#2-56	NUT. LARGE PATTERN
11	12	#2-56 x 3/8	PBHMS
10	2	76-0013	SHELL NUT
9	1	1911-4	#4 GROUND LUG
8	2	2-76-0001-38	STANDOFF
7	4	#4	INT TOOTH LOCKWASHER
6	2	#4-40 x 1/4	PBHMS
5	1	205208-1	25 PIN CONNECTOR
4	4	1-76-0101	MODIFIED CONNECTOR
3	1	2-16-0072	MOUNTING BLOCK
2	1	16-0176	PHASE LOCK P.C. BD
1	1	16-0202	PHASE LOCK BD. MECH ASS'Y

NEXT ASS'Y	QT'Y	MODEL
		NAV-75O

PHASE LOCK BD. MECH. ASS'Y

APPLICATION

LIST OF MATERIALS

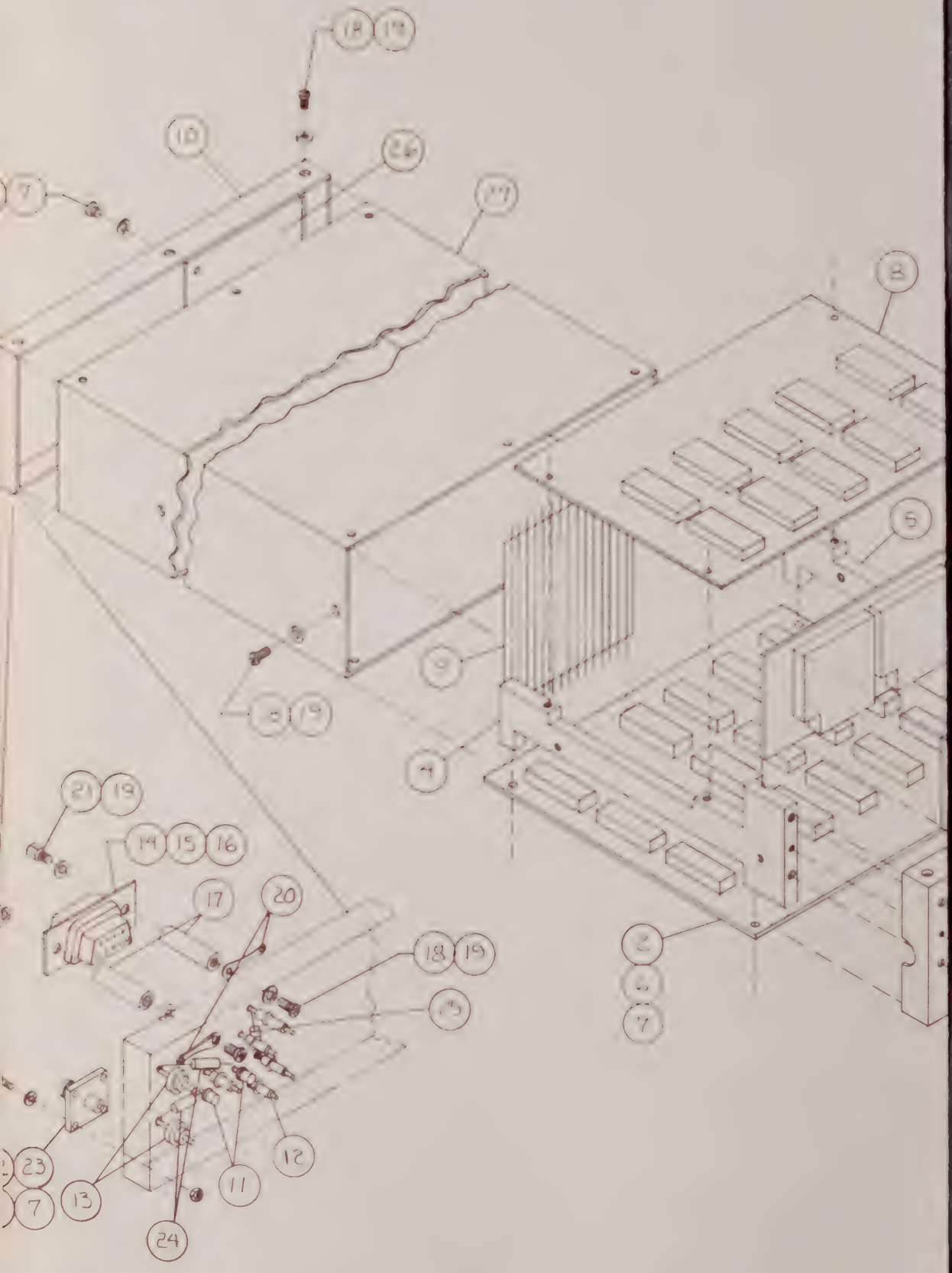
TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

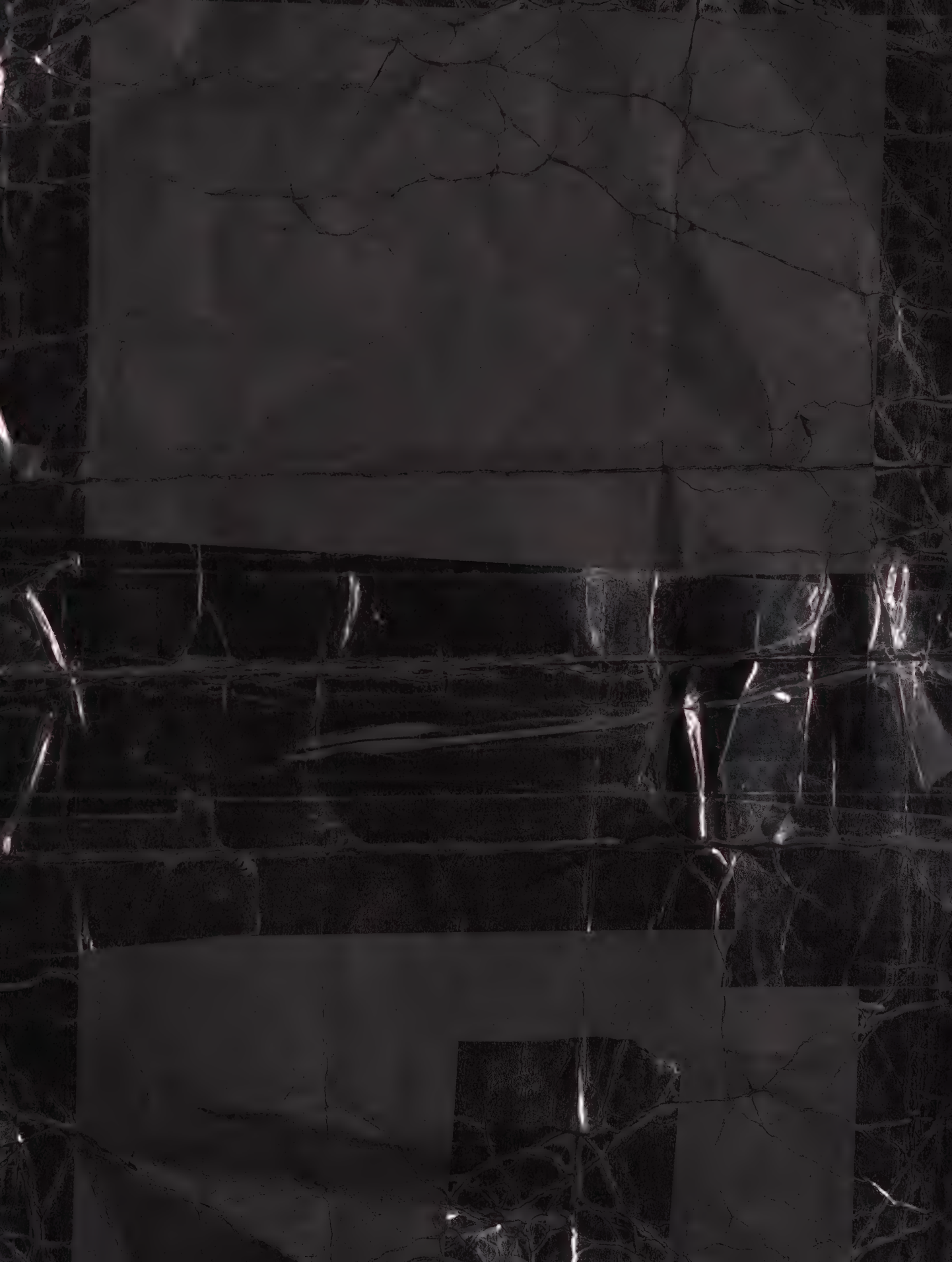
	DRAWN	DATE
	WP	1-14-75
CHECKED		DATE
	2-21-75	
APPROVED		DATE
		2-26-75

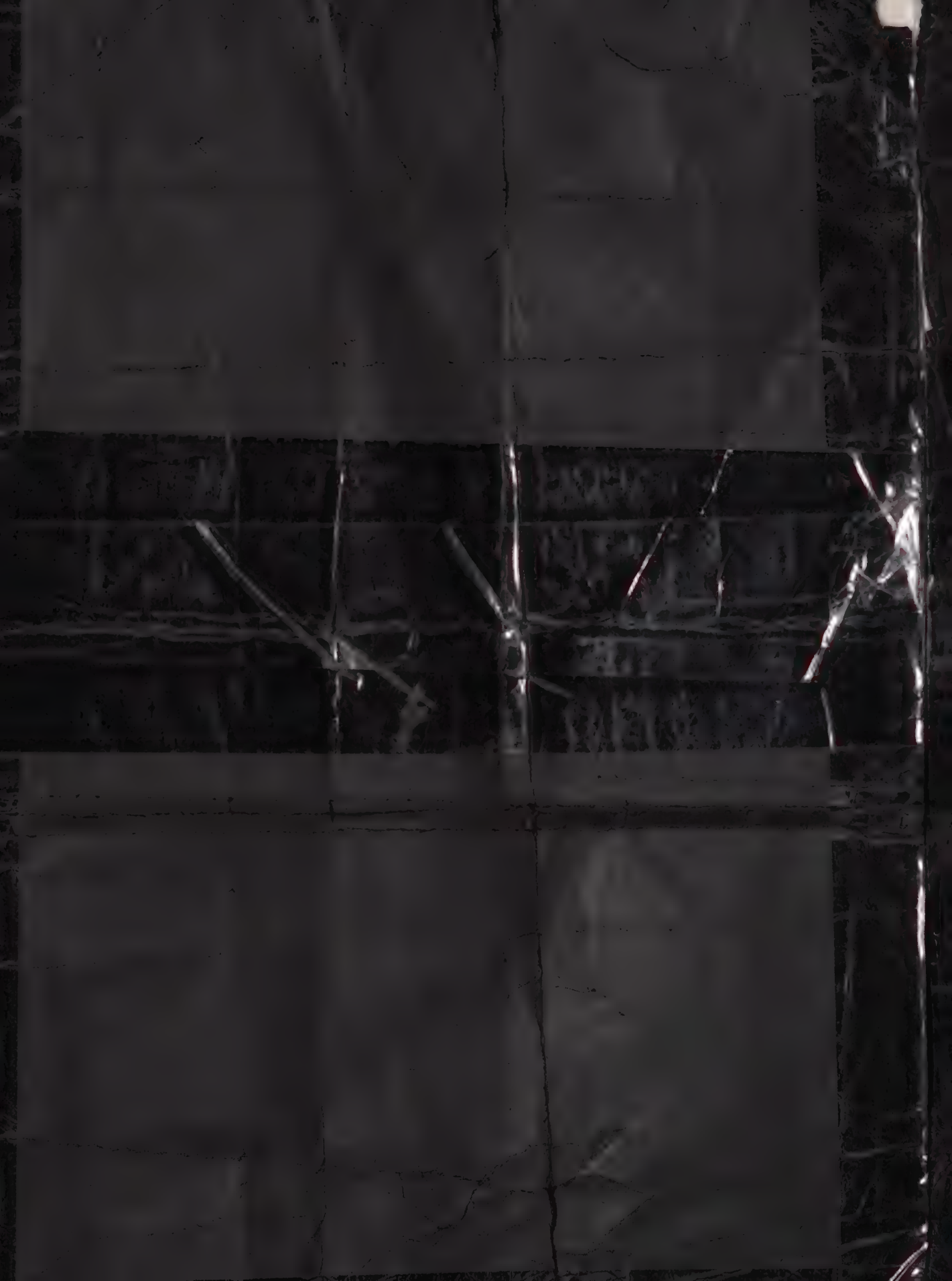
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE
12.5 kHz PHASE LOCK BOARD
MECHANICAL ASS'Y

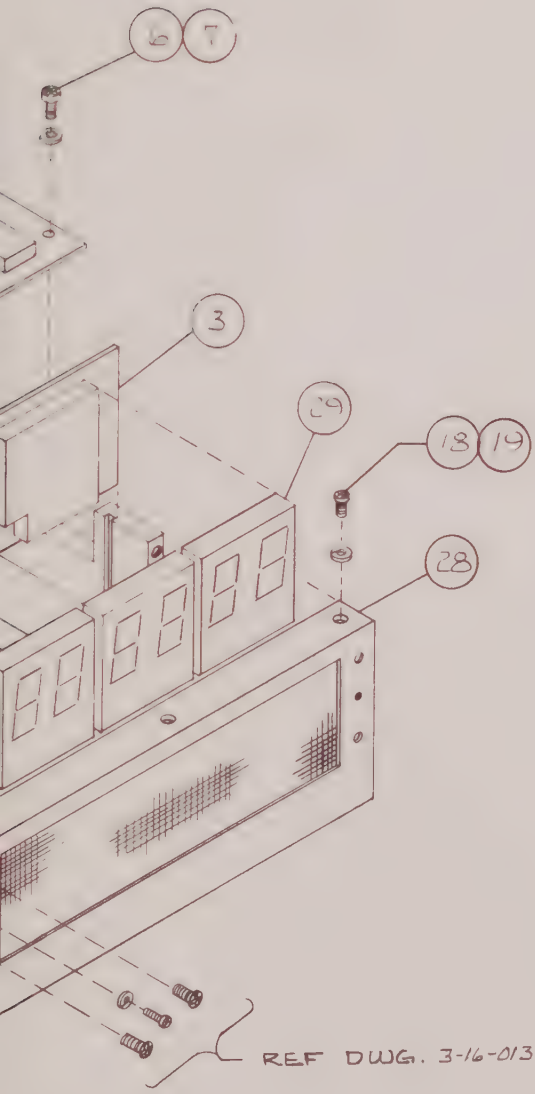
MATERIAL	SIZE	PART NUMBER	REV
	C	3-16-0206	
TREATMENT	SCALE	WEIGHT	
	AS SHOWN		SHEET 3 OF 3
FINISH			


18
19
10
24
7
27
8
5
9
3
19
4
21
19
14
15
16
17
20
18
19
3
2
6
7
23
7
13
11
12
24





DATE	REV	CHANGE	APP'D
2/19/75	B	REVISED & REDRAWN PER ECN# 343 3D	



ITEM	REQ'D	PART NO.	DESCRIPTION
29	3	SP352	REF. "SPERRY" READOUT
28	1	2-16-0201	FRONT PLATE ASS'Y.
27	1	3-16-0199	COUNTER ENCLOSURE
26	1	1-16-0222	DIVIDER P.C. BOARD ASSY
25	1	RCR07	"ALAN BRADLEY. RES 10K
24	2	RCR07	"ALLEN BRADLEY RES 680Ω
23	4	#2-56	SMALL PATTERN HEX NUT
22	1	1-76-0111	MOD. FD. "AMERICON" CONN.
21	2	1-76-0013-1	SHELL NUT
20	4	1411-4	"H-H SMITH" GND. LUG.
19	20	#4	INT. TOOTH L.W.
18	18	#4-40x3/16	PHIL. BIND HD MACH SCW
17	2	2-16-0001-38	SPACER
16	8	205310-2	"AMP" MALE CRIMP PIN
15	1	205202-4	"AMP" MALE CRIMP PIN
14	1	205204-1	"AMP" 9 PIN MALE CONN.
13	2	FASC-470W	"ALLEN-BRADLEY" FEED THRU
12	5	1203-050	"ERIE" FEED THRU
11	2	STSM-2C4	"SCALECTRO" STAND OFF
10	1	2-16-0200	BACK PLATE
9	1	.125-P901 52-14	"ANSLEY" FLEX STRIP.
8	1	1-16-0159	GATING. P.C. BOARD. ASSY
7	14	#2	INT. TOOTH L.W.
6	14	#2-56x1/4	PHIL. BIND HD. MACH SCW.
5	1	2-16-0065-2	MTG. BRKT.
4	1	2-16-0065-1	MTG. BRKT
3	1	1-16-0160	DISPLAY P.C. BOARD ASSY
2	1	1-16-0158	READOUT P.C. BOARD ASSY.
1	1	1-16-0034	DIGITAL READOUT ASS'Y.

LIST OF MATERIALS

NEXT ASS'Y	QT'Y	MODEL
	1	NAV-750

APPLICATION

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 J
REMOVE ALL BURRS

	DATE
DRAWN	1-6-75
CHECKED V.E	2-17-75
APPROVED	2-17-75

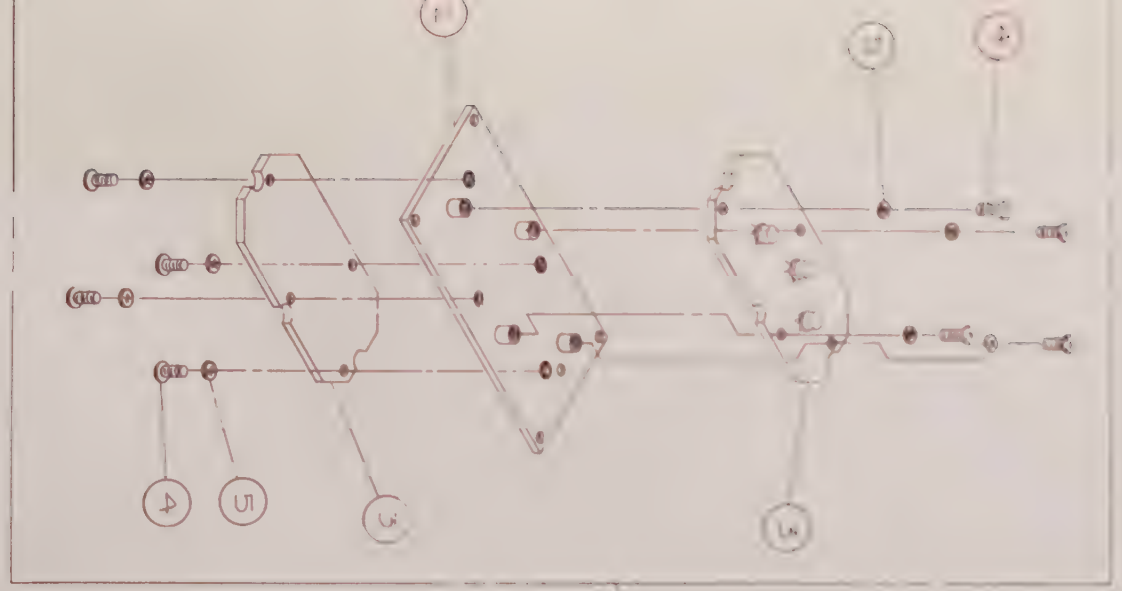
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

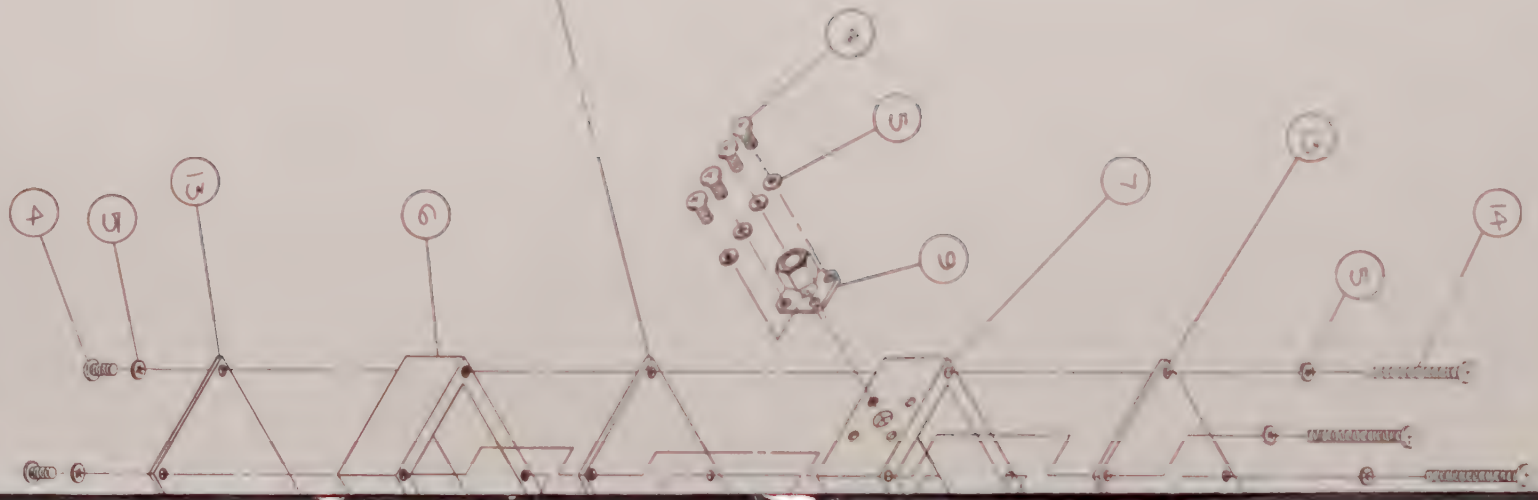
TITLE: DIGITAL READOUT ASS'Y.

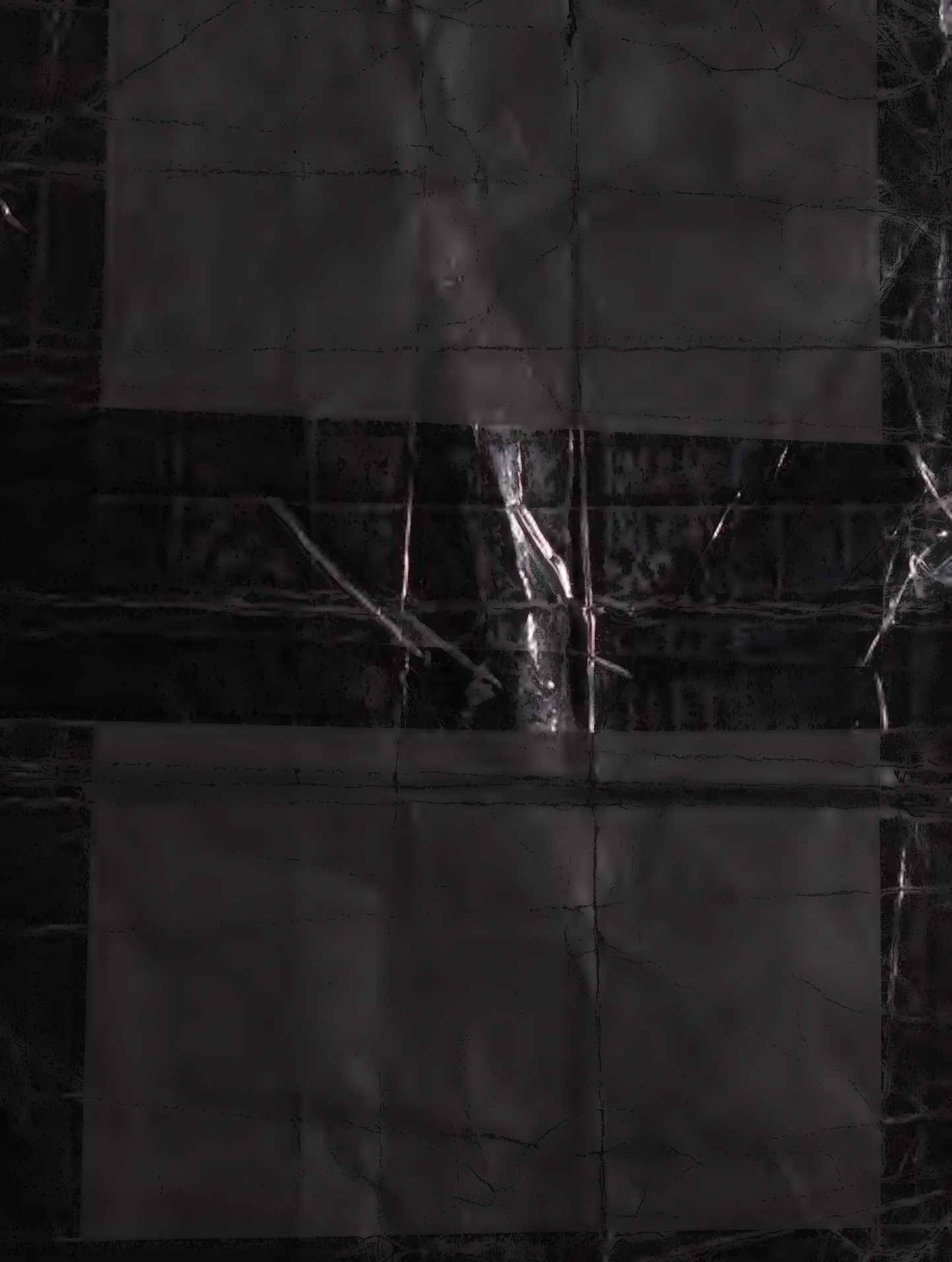
MATERIAL: NOTED
TREATMENT:
FINISH:

SIZE: —
PART NUMBER: 3-16-0034.
REV: B
SCALE: NONE
WEIGHT:
SHEET 1 OF 1

FIG. 8-12







DATE	REV	CHANGE	APP'D

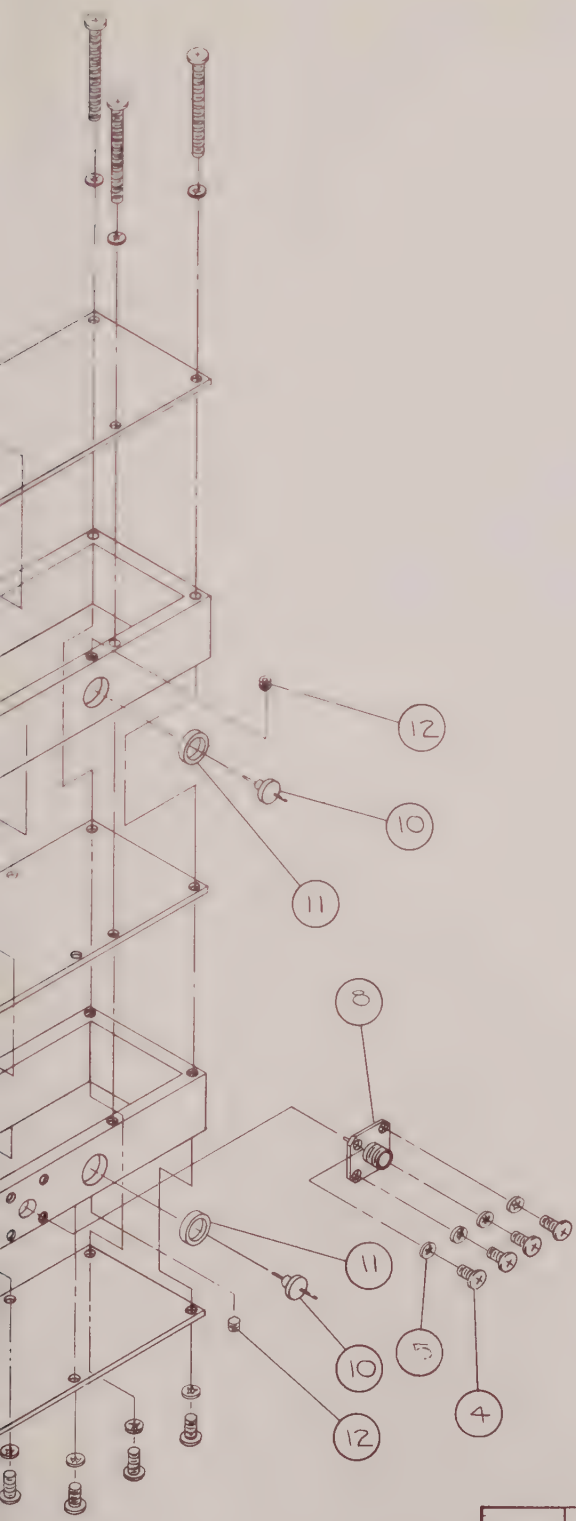


FIG. 8-13

ITEM	REQ'D	PART NO.	DESCRIPTION
14	6	"2-56x3/8	PHIL. SCREW, BND HD
13	2	16-0169	BUFFER/AMP COVER
12	2	"2-56x1/8	SET SCREW, SOCKET HD
11	2	2-76-8001-18	CAP BUSHING
10	2	FASCF-102W	1000 PF FEEDTHRU CAP
9	1	760112	MODIFIED CONNECTOR
8	1	76-0111	MODIFIED CONNECTOR
7	1	160166	BUFFER HSG SECT. (1)
6	1	16-0167	BUFFER HSG SECT. (2)
5	28	"2	INT TOOTH LOCKWASHER
4	22	"2-56x1/4	PHIL. SCREW, BND HD
3	2	160164	PC BD ASS'Y
2	1	160168	CKT BD MTG PLATE
1	1	160161	BUFFER/AMP ASS'Y

NEXT ASS'Y	QTY	MODEL
	1	NAV-750

APPLICATION

LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .XX = ± .010 .XXX = ± .006
ANGLES ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

DRAWN JNV 10/25/73
CHECKED MWA 11/7/73
APPROVED

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

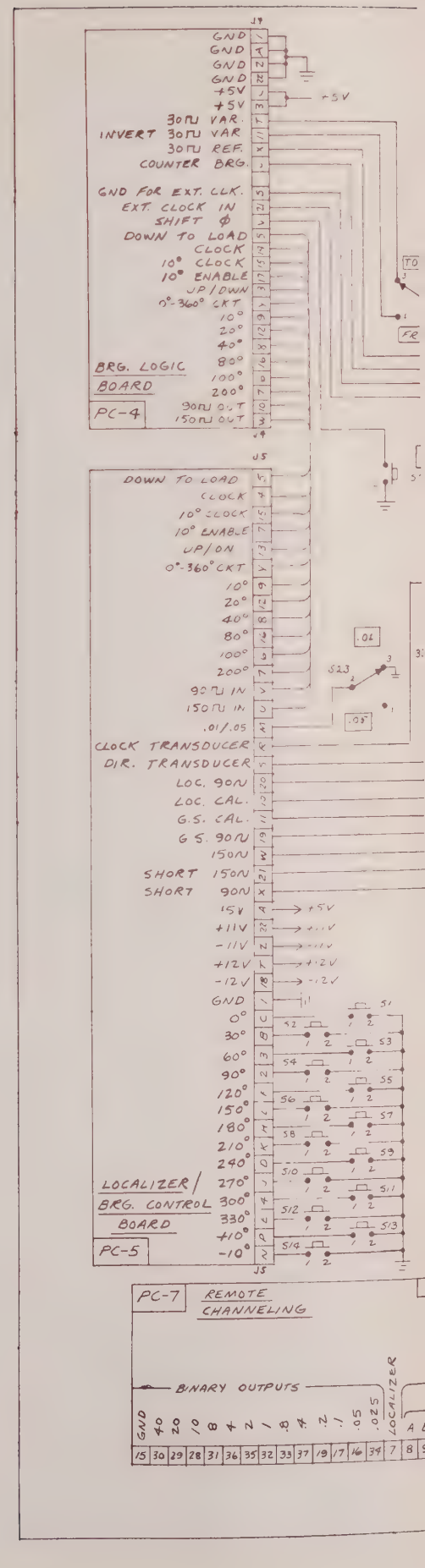
TITLE
DUAL BUFFER/AMP
MECHANICAL ASSEMBLY
NAV-750

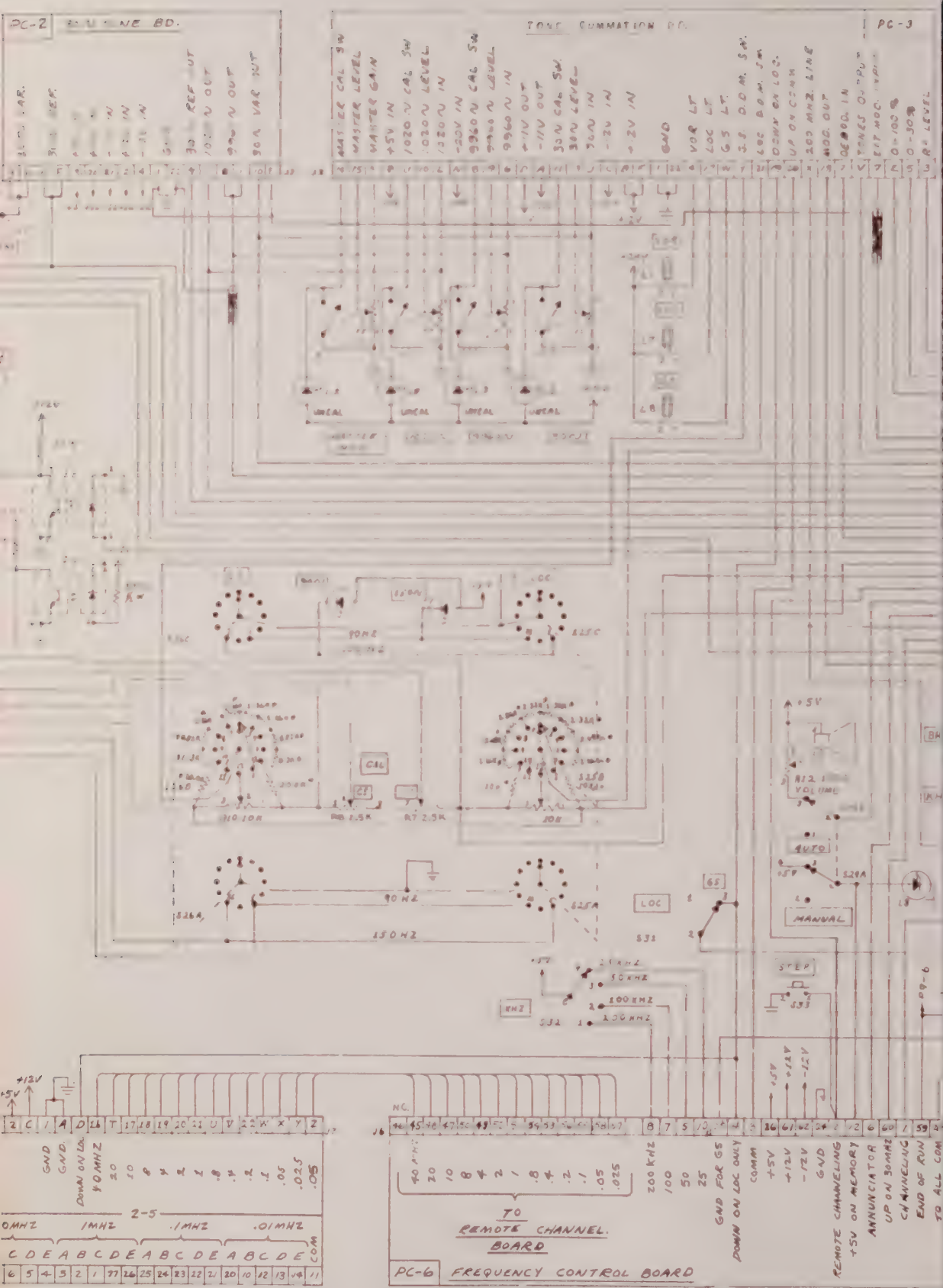
MATERIAL ASSEMBLY
TREATMENT
FINISH

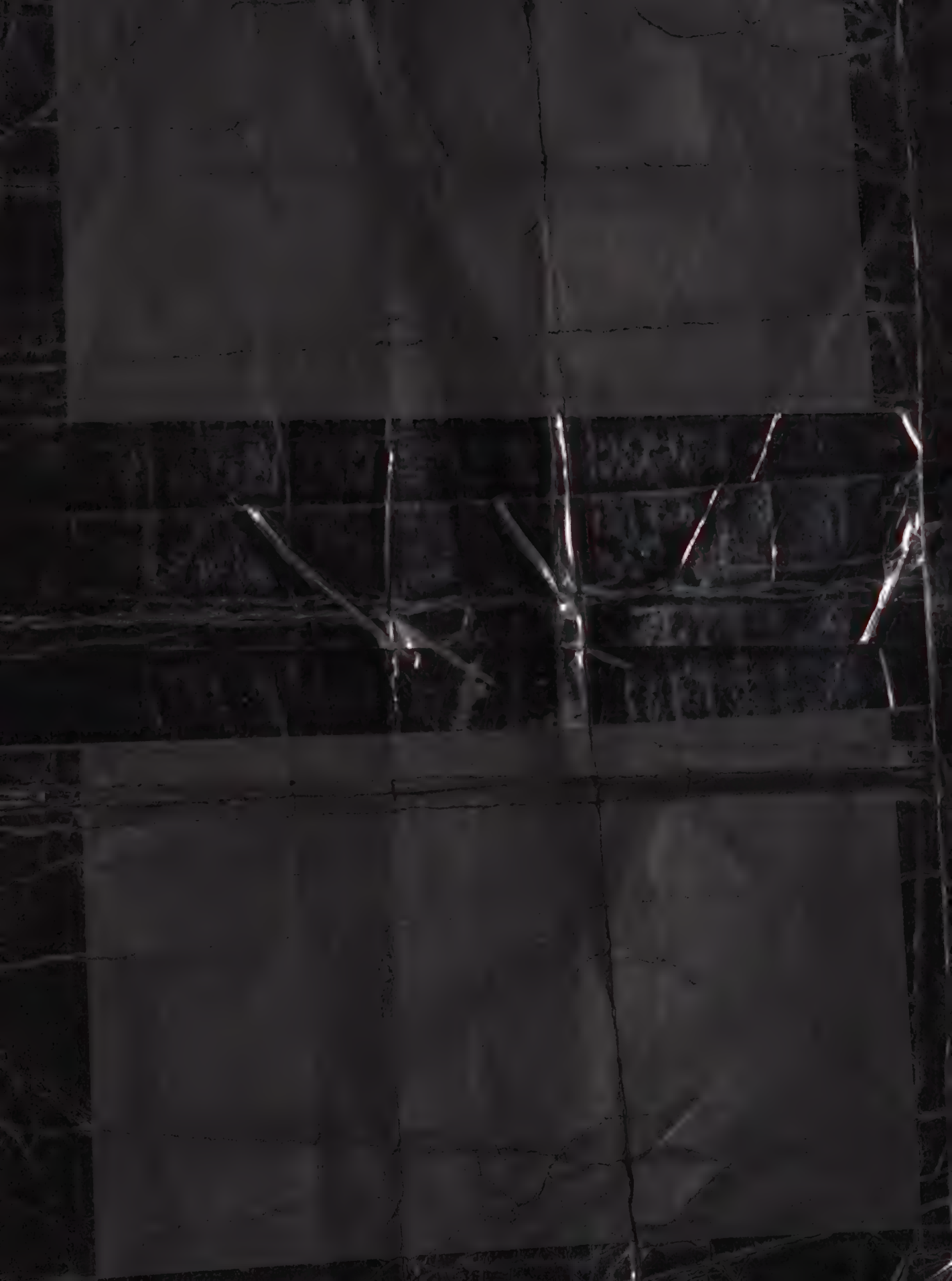
SIZE | PART NUMBER 3-16-0161 | REV

SCALE 1 : 1 | WEIGHT | SHEET 1 OF 1

ASSEMBLY


J4
GND
GND
GND
GND
+5V
+5V
30πN VAR.
INVERT 30πN VAR
30πN REF.
COUNTER BRG.
GND FOR EXT. CLK.
EXT. CLOCK IN
SHIFT Ø
DOWN TO LOAD
CLOCK
10° CLOCK
10° ENABLE
UP/DOWN
0°-360° CKT
10°
20°
40°
80°
100°
200°
90πN OUT
150πN OUT
BRG. LOGIC BOARD
PC-4
J5
DOWN TO LOAD
CLOCK
10° CLOCK
10° ENABLE
UP/DN
0°-360° CKT
10°
20°
40°
80°
100°
200°
90πN IN
150πN IN
.01/.05
CLOCK TRANSDUCER
DIR. TRANSDUCER
LOC. 90N
LOC. CAL.
G.S. CAL.
G.S. 90N
150N
SHORT 150N
SHORT 90N
15V
+11V
-11V
+12V
-12V
GND
0°
30°
60°
90°
120°
150°
180°
210°
240°
270°
300°
330°
+10°
-10°
LOCALIZER/ BRG. CONTROL BOARD
PC-5
+5V
.01
.05
S23
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12
S13
S14
PC-7
REMOTE CHANNELING
BINARY OUTPUTS
GND
40
20
10
8
4
2
1
.8
.4
.2
.1
.05
.025
LOCALIZER
15 30 29 28 31 36 35 32 33 37 19 17 16 34 7 8


PC-2
TONE COMMATION BD.
PC-3
MASTER CAL SW
MASTER LEVEL
MASTER GAIN
+5V IN
1020 ~ CAL SW
1020 ~ LEVEL
1020 ~ IN
-20V IN
9960 ~ CAL SW
9960 ~ LEVEL
9960 ~ IN
+11V OUT
-11V OUT
30 ~ CAL SW
30 ~ LEVEL
30 ~ IN
-12V IN
+12V IN
GND
VOR LT
LOC LT
G.S. LT
G.S. D.D.M. SW
LOC D.D.M. SW
DOWN ON LOC
UP ON COMM
200 MHZ LINE
MOD. OUT
DEMOD. IN
TONES OUTPUT
EXT MOD. INPUT
0-100%
0-30%
R4 LEVEL
UNCAL
UNCAL
UNCAL
UNCAL
90 HZ
150 HZ
CAL
R8 1.5K
R7 2.5K
10K
+5V
R12 VOLUME
AUTO
MANUAL
LOC
GS
S31
S32
S33
S29A
S26A
S25A
S25B
S25C
KHZ
50 KHZ
100 KHZ
200 KHZ
STEP
+12V
+5V
GND
GND
DOWN ON LOC
40 MHZ
20
10
8
4
2
1
.8
.4
.2
.1
.05
.025
.05
2-5
0MHZ
1MHZ
.1MHZ
.01MHZ
C D E A B C D E A B C D E A B C D E COM
TO
REMOTE CHANNEL
BOARD
200 KHZ
100
50
25
GND FOR GS
DOWN ON LOC ONLY
COMM
+5V
+12V
-12V
GND
REMOTE CHANNELING
+5V ON MEMORY
ANNUNCIATOR
UP ON 30MHZ
CHANNELING
END OF RUN
TO ALL COM
PC-6
FREQUENCY CONTROL BOARD



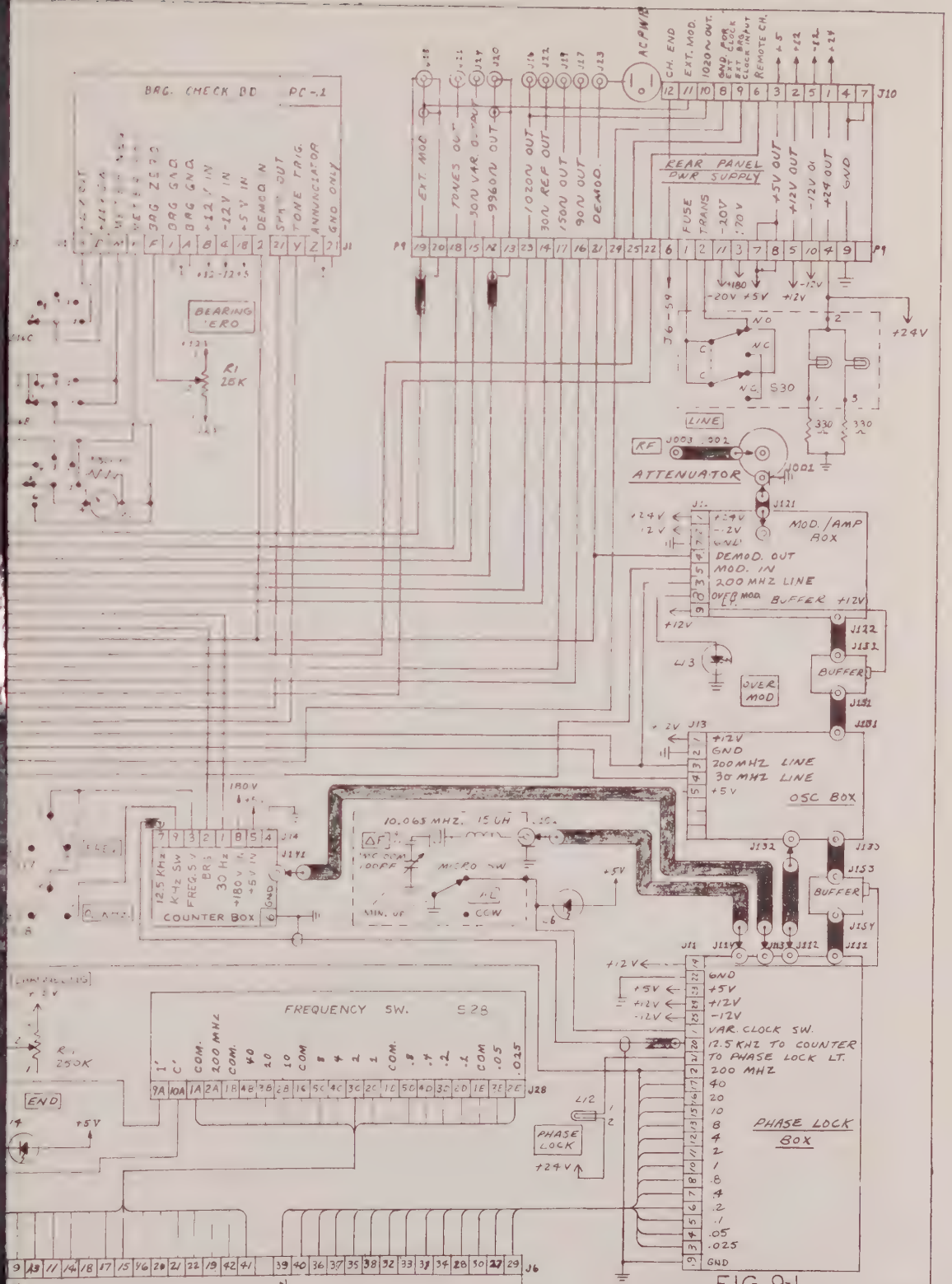


FIG. 9-1

DATE	REV	CHANGE	APP'D
10/14/74	B	INCORPORATED ECN #2 JNV	10-15-74
6/5/74	A	INCORP. ECN-1 STP	

INSTRUMENT FLIGHT RESEARCH CORP.
4053 Navajo Lane
Wichita, Ks.

NAV-750
INTERCONNECT DIAGRAM

DWN JTG DATE 8-1-73
CHKD RR DATE 8-9-73
APP DATE 1 17 74
PART NO 4-16-0141
REV F DATE 1-23-75
DWN JNV
APP
SCALE
MODEL NAV-750
SHT. 1 of 1

1/23/75	F	INCORP ECN #170 SP		1/7/75	D	INCORP ECN SER 122 GLD	
1/9/75	E	INCORP ECN 133 GLD		1/7/75	C	INCORP ECN SER 008 GLD	

DATE	REV	CHANGE	APP'D

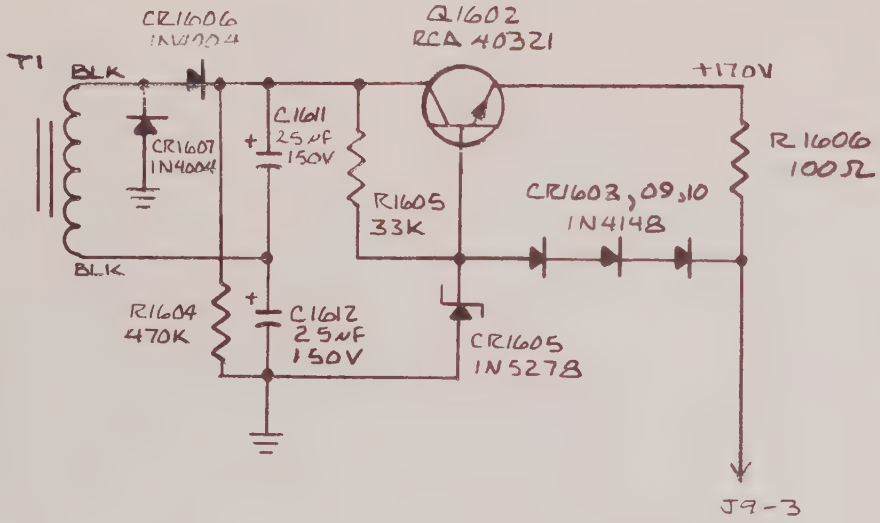


FIG. 9-2

NOTE:

1. REF. ECN #1 OF 3-16-0142A FOR DETAILS OF CHANGES & REASON FOR SEPARATE PRINT OF THIS CKT.

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
———	—	NAV-760	1	1	1-16-0224	SCHEMATIC

APPLICATION

LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

DRAWN DATE 11-13-74
CHECKED DATE 11-13-74
APPROVED DATE 11-20-74

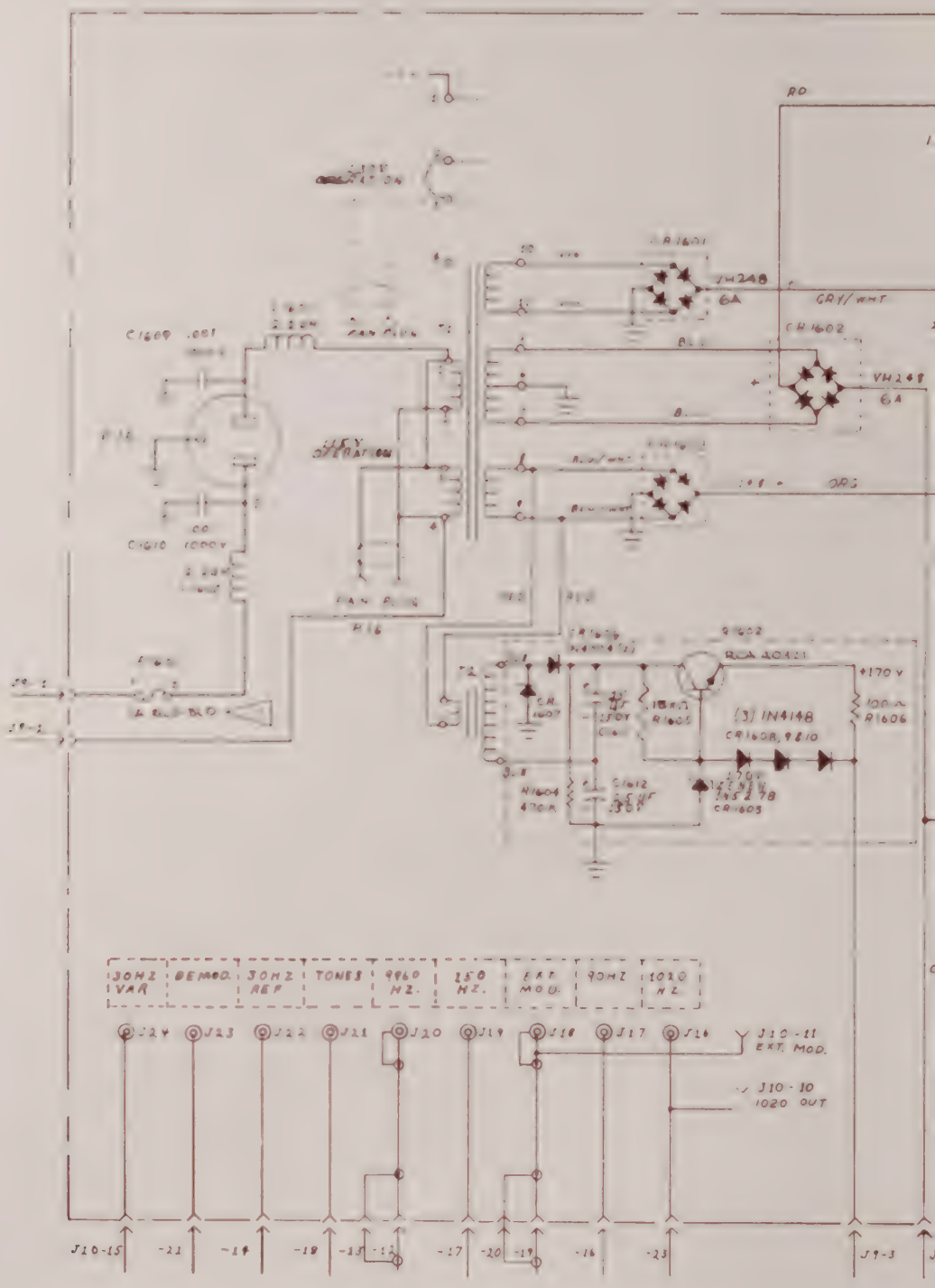
MATERIAL
TREATMENT
FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE
H.V. SHORT CIRCUIT PROTECT (SCHEMATIC)

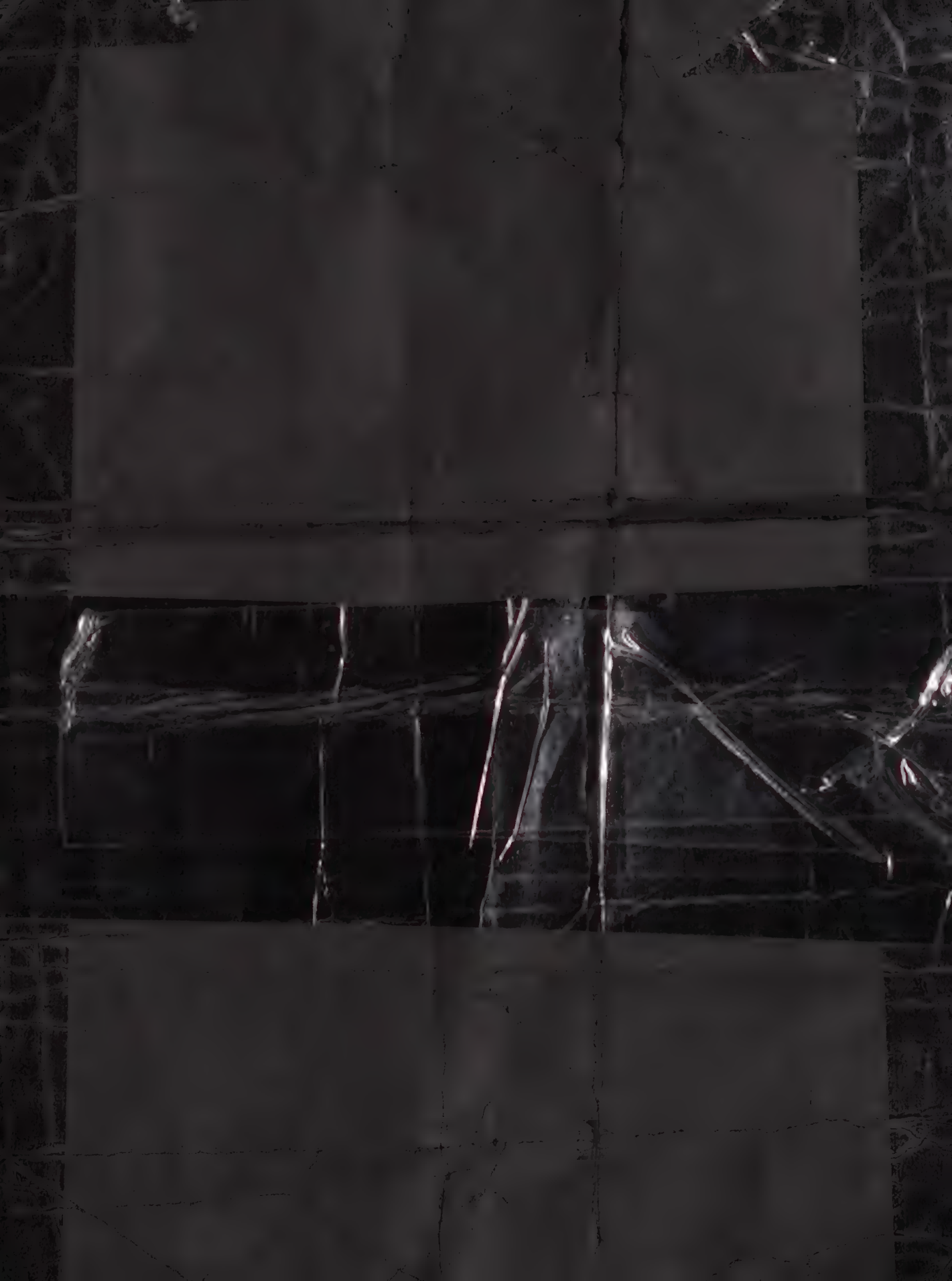
SIZE	PART NUMBER	REV
	1-16-0224	

SCALE — WEIGHT — SHEET 1 OF 1



NOTES:

1. USE 1/2 AMP SLO-BLO FUSE FOR 220V OPERATION.



DATE	REV	CHANGE	APP'D
6/6/72	A	INCORP. ECN-1	
7/5/72	B	INCORPORATED ECN#2	
1/24/73	C	INCORPORATED ECN # 221	SBD
7/19/73	D	INCORPORATED ECN #259	SBD

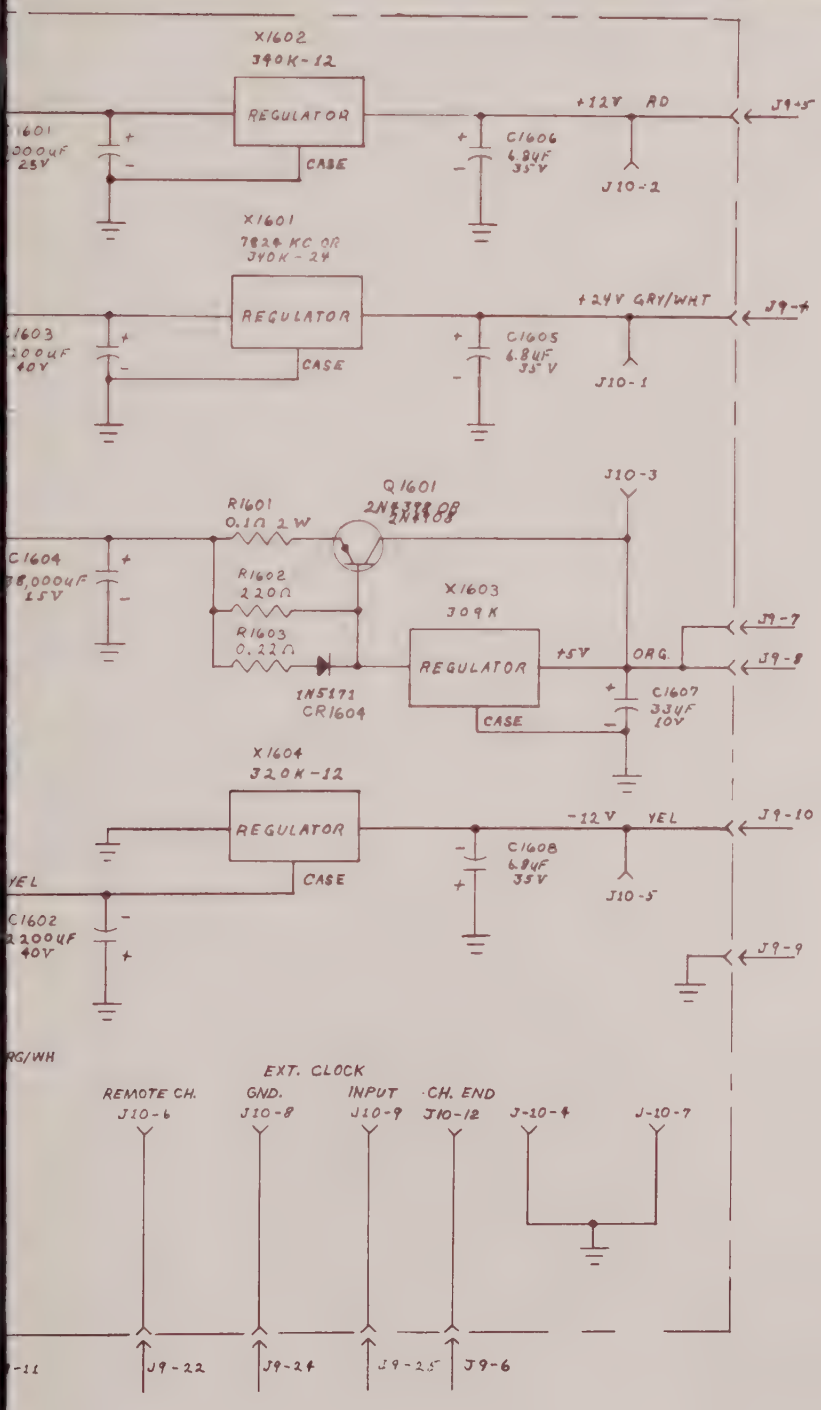


FIG. 9-3

NEXT ASS'Y	QT'Y	NAV 750 MODEL	ITEM	REQ'D	PART NO.	SCHEMATIC DESCRIPTION
APPLICATION						LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

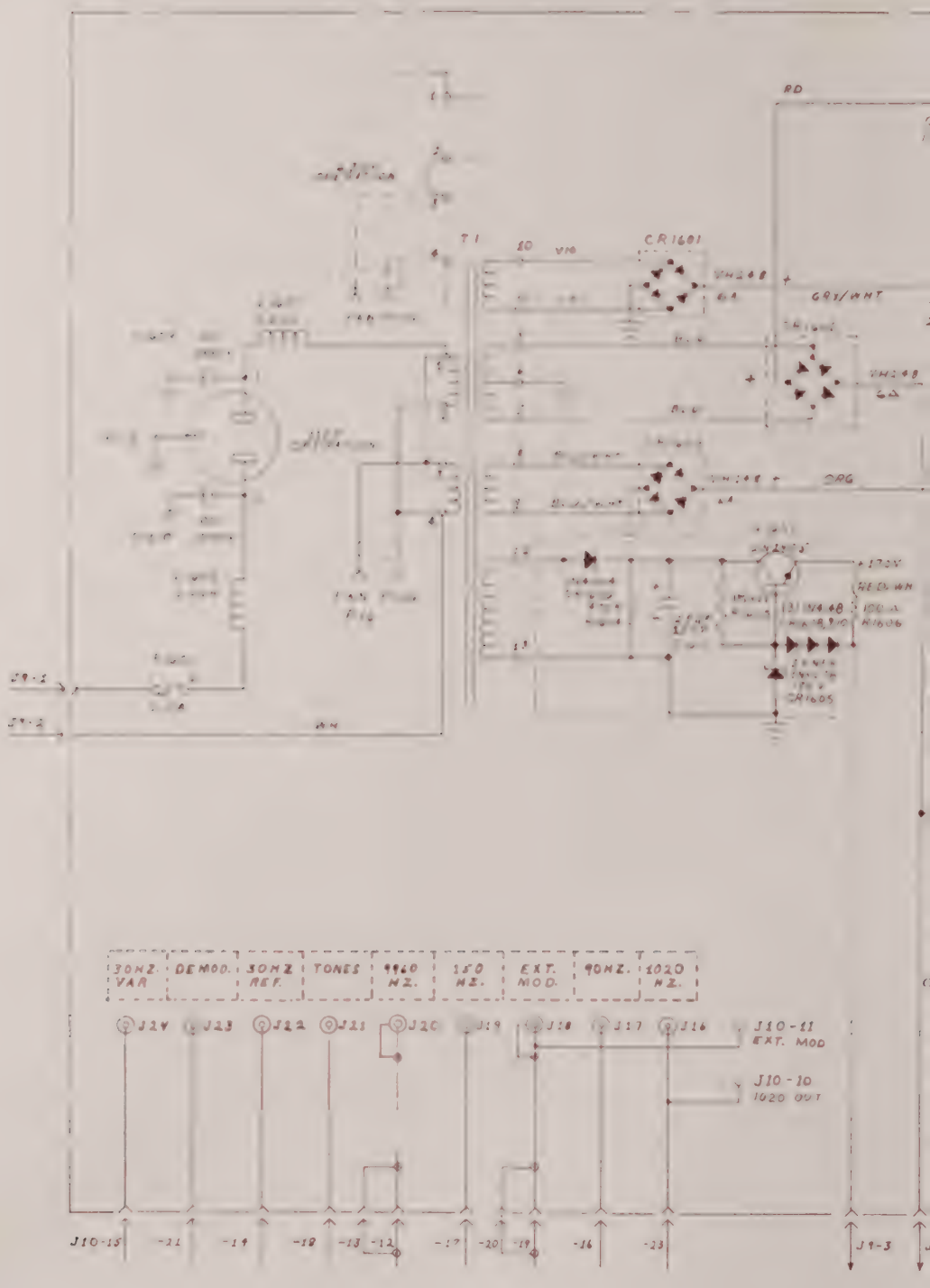
MATERIAL
TREATMENT
FINISH

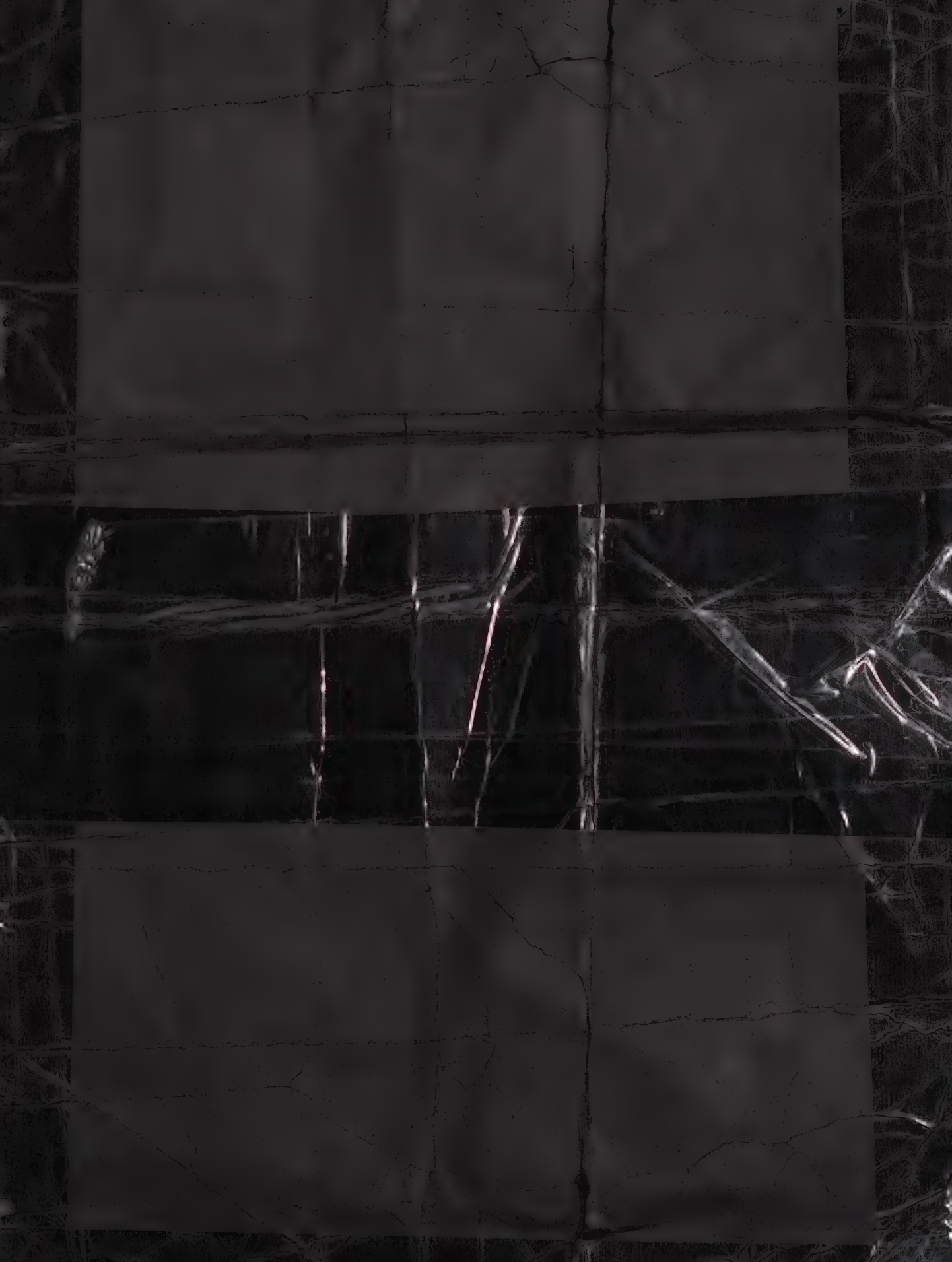
DRAWN WP 8-13-73
CHECKED RR 8-31-73
APPROVED JB 9-14-73

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE
NAV 750 POWER SUPPLY
EFFECTIVE S/N 101 – 270

SIZE C | PART NUMBER 3-16-0142A | REV D
SCALE | WEIGHT | SHEET 1 OF 1


RD
T1
CR1601
GRY/WHT
ORG
CR1605
30HZ. VAR
DEMOD.
30HZ REF.
TONES
9960 HZ.
150 HZ.
EXT. MOD.
90HZ.
1020 HZ.
J10-11 EXT. MOD
J10-10 1020 OUT



DATE	REV	CHANGE	APP'D
7-7-72	A	INCORPORATED ECN # 1	JNJ
1-24-75	B	INCORPORATED ECN # 222	SBD
7-30-75	C	INCORPORATED ECN # 254	SBD

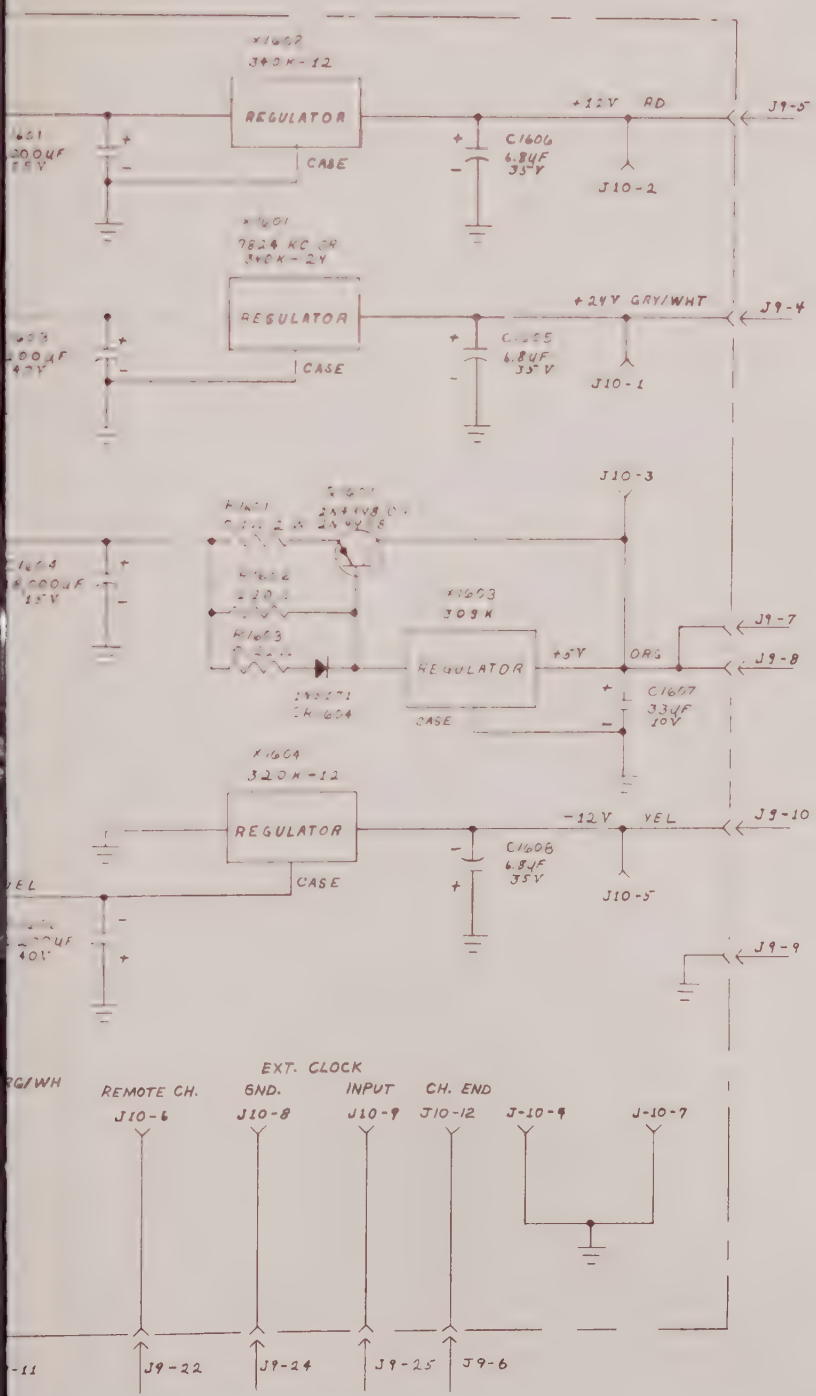


FIG. 9-4

NEXT ASS'Y	QT'Y	NAV 750 MODEL	ITEM	REQ'D	PART NO.	SCHEMATIC DESCRIPTION
APPLICATION						LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 √
REMOVE ALL BURRS

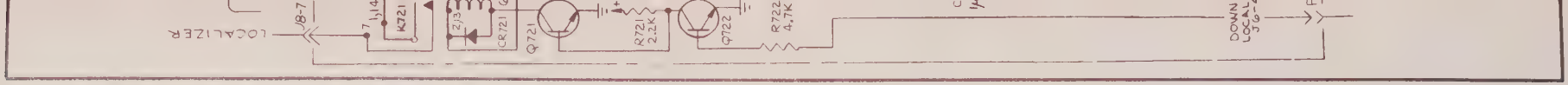
DRAWN WFP 8-1-73
CHECKED RP 8-31-75
APPROVED

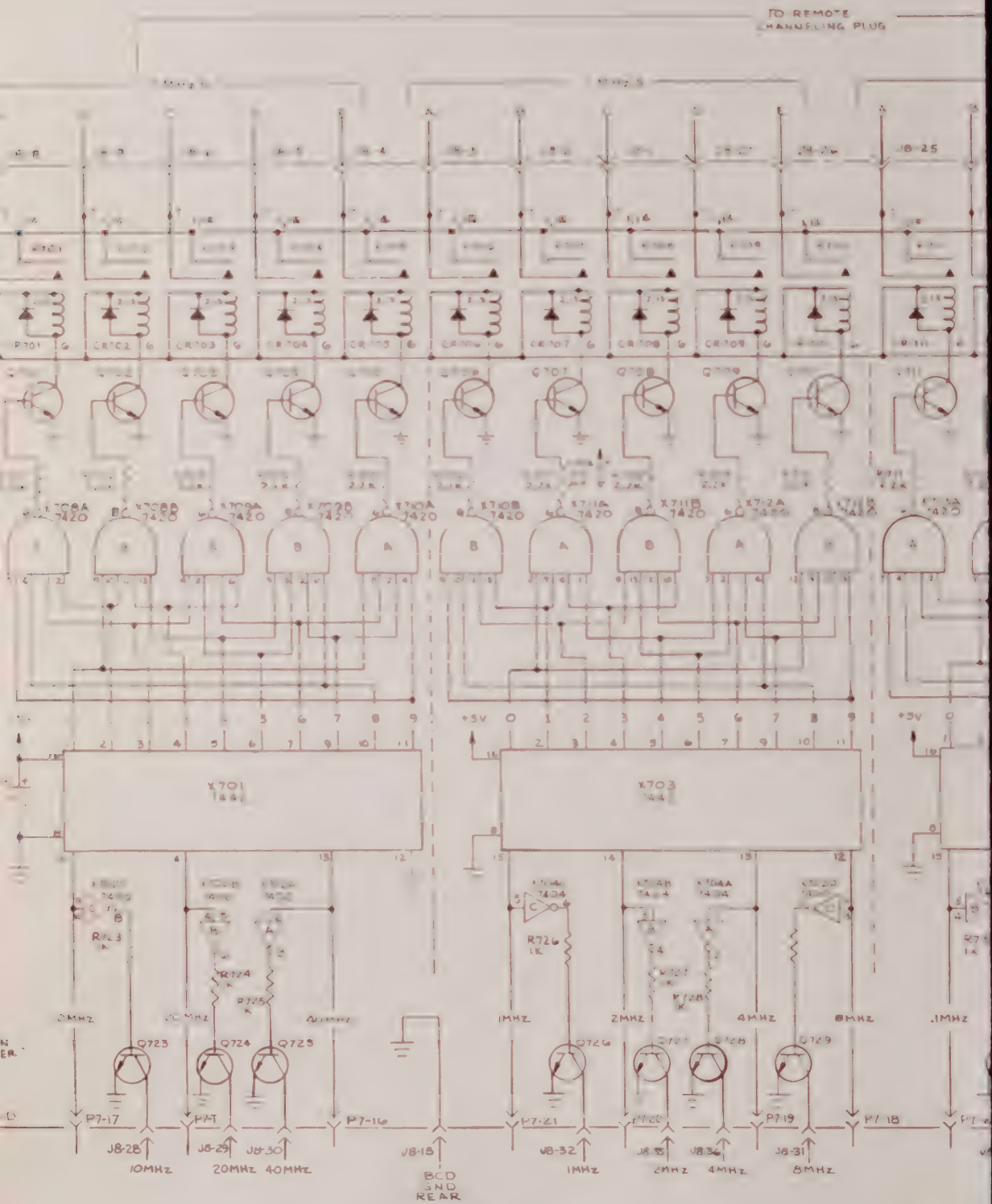
MATERIAL
TREATMENT
FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: NAV 750 POWER SUPPLY
EFFECTIVE S/N 271 ON

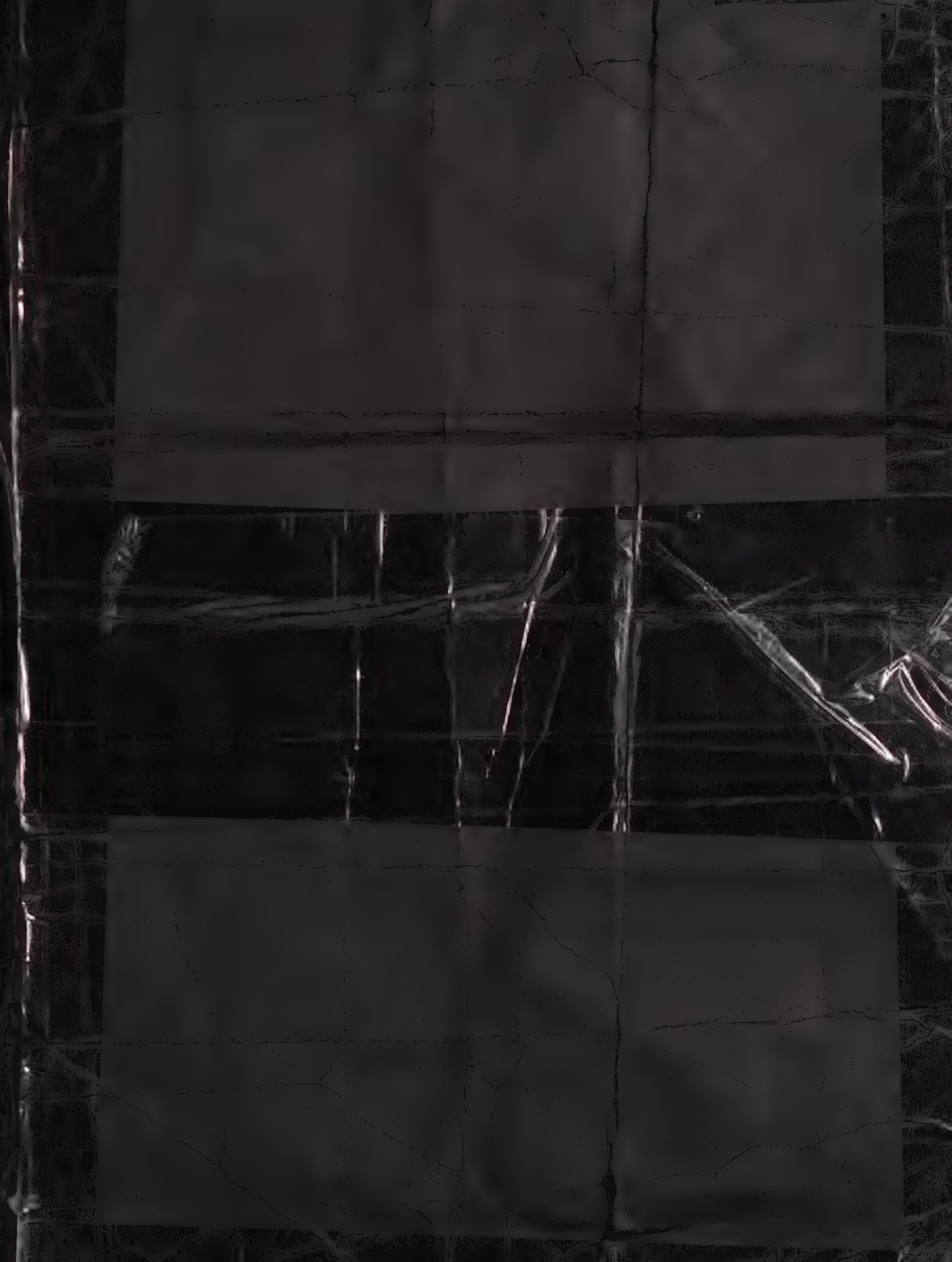
SIZE C | PART NUMBER 3-16-01428 | REV C
SCALE | WEIGHT | SHEET 1 OF 1

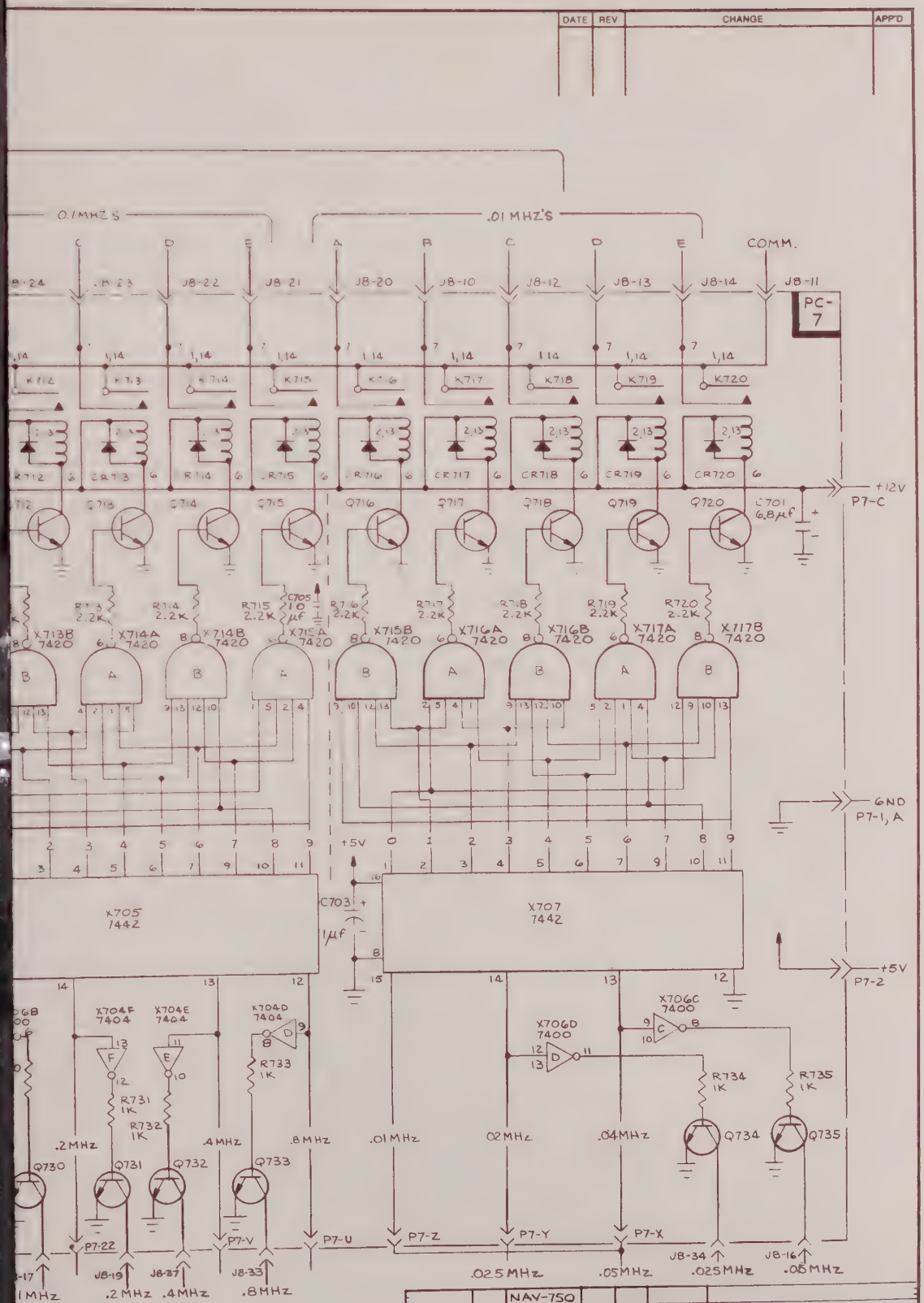

LOCALIZER
J8-7
J,14
K721
Z,3
CR721
Q721
R721
2.2K
Q722
R722
4.7K
DOWN
LOCAL
J9-1



NOTES
1. RELAYS ARE TYPE 117 DIP-3 (SPST) MAGNECRAFT
2. TRANSISTORS ARE TYPE 2N3415
3. DIODES ARE TYPE IN4148.

FIG





NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
		NAV-750				

APPLICATION — LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .XX = ± .010 .XXX = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN JIG DATE 3/15/73
CHECKED MD DATE 2 10 75
APPROVED DATE 2-18-75

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE
REMOTE CHANNELING BOARD — SCHEMATIC
NAV-750 PC-7

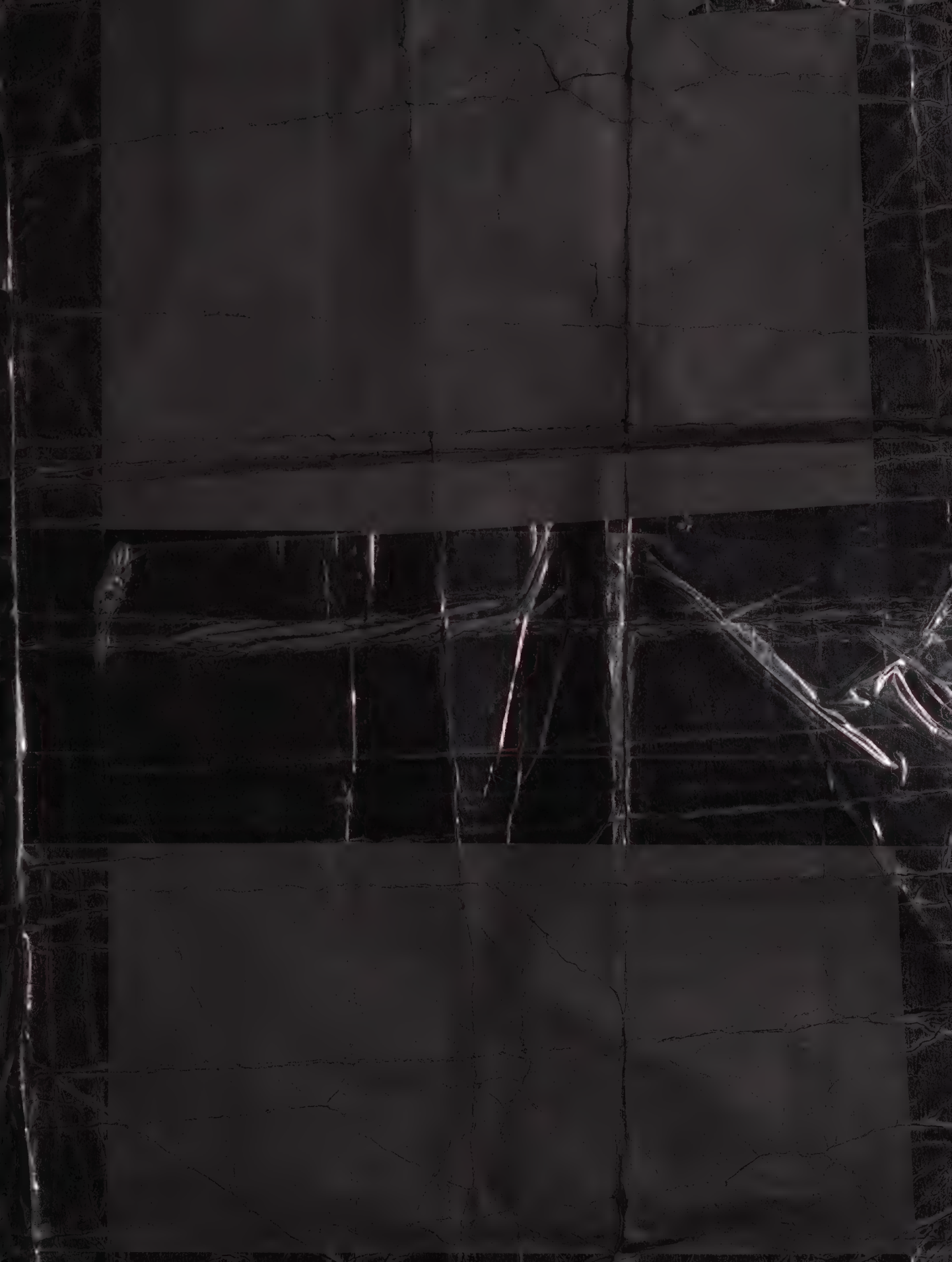
SIZE C — PART NUMBER 3-16-0018 — REV

SCALE — WEIGHT — SHEET 1 OF 2

MATERIAL
TREATMENT
FINISH

3-16-0012
ARTWORK
VIOLET
EJECTORS
1-16-0042
PARTS LIST

9-5



DATE	REV	CHANGE	APP'D

LOCALIZER

P7	
[illegible]	
N	
[illegible]	
[illegible]	
14	
[illegible]	
[illegible]	
[illegible]	
16	40 MHZ
T	20 MHZ
17	0 MHZ
U	.8 MHZ
18	8 MHZ
V	4 MHZ
[illegible]	4 MHZ
W	.1 MHZ
20	2MHZ
[illegible]	.04 MHZ
2	1 MHZ
Y	02 MHZ
22	2 MHZ
Z	01 MHZ

J8	
1	C (1MHZ'S)
2	B (1MHZ'S)
3	A (1 MHZ'S)
4	E (10MHZ'S)
5	D (10 MHZ'S)
6	C (10MHZ'S)
7	LOCALIZER
8	A (10MHZ'S)
9	B (10MHZ'S)
10	B (.01 MHZ'S)
11	COMMON
12	C (.01 MHZ'S)
13	D (.01 MHZ'S)
14	E (.01 MHZ'S)
15	BCD GND REAR
16	.05 MHZ
17	.1 MHZ
18	
19	.2 MHZ

J8	
20	A (.01 MHZ'S)
21	E (.1MHZ'S)
22	D (.1MHZ'S)
23	C (.1MHZ'S)
24	B (.1MHZ'S)
25	A (.1MHZ'S)
26	E (1MHZ'S)
27	D (1MHZ'S)
28	10 MHZ
29	20 MHZ
30	40 MHZ
31	8 MHZ
32	1 MHZ
33	.8 MHZ
34	.025 MHZ
35	2 MHZ
36	4MHZ
37	.4 MHZ

FIG. 9-6

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
						VIOLET EJECTORS
	1	NAV-750	—	1	3-16-0018	REMOTE CHAN. BOARD

APPLICATION — LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

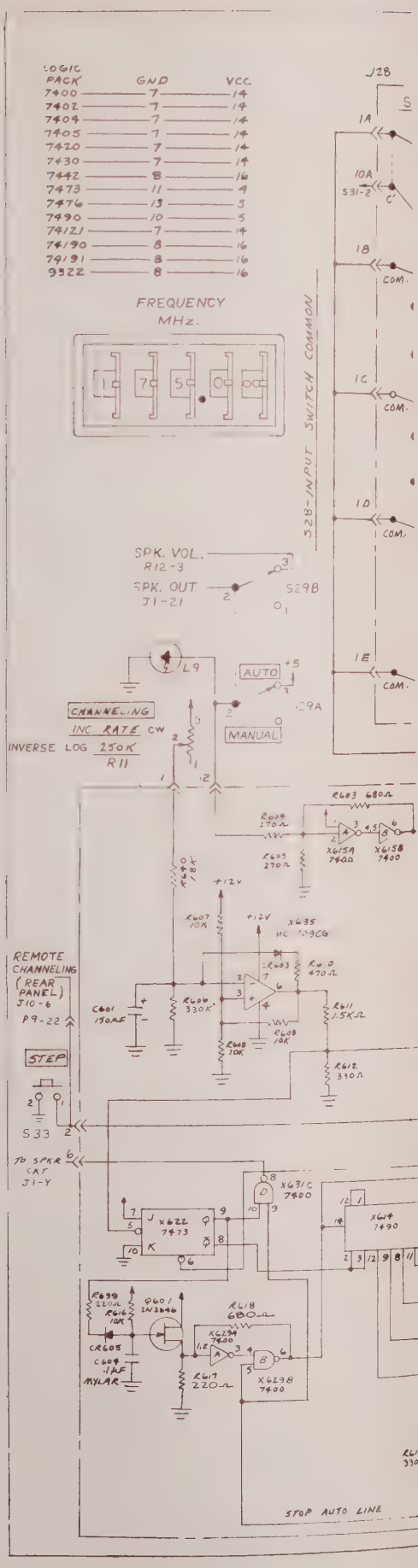
DRAWN JIG DATE 5/11/73
CHECKED MHL DATE 2-18-73
APPROVED DATE 7-24-73

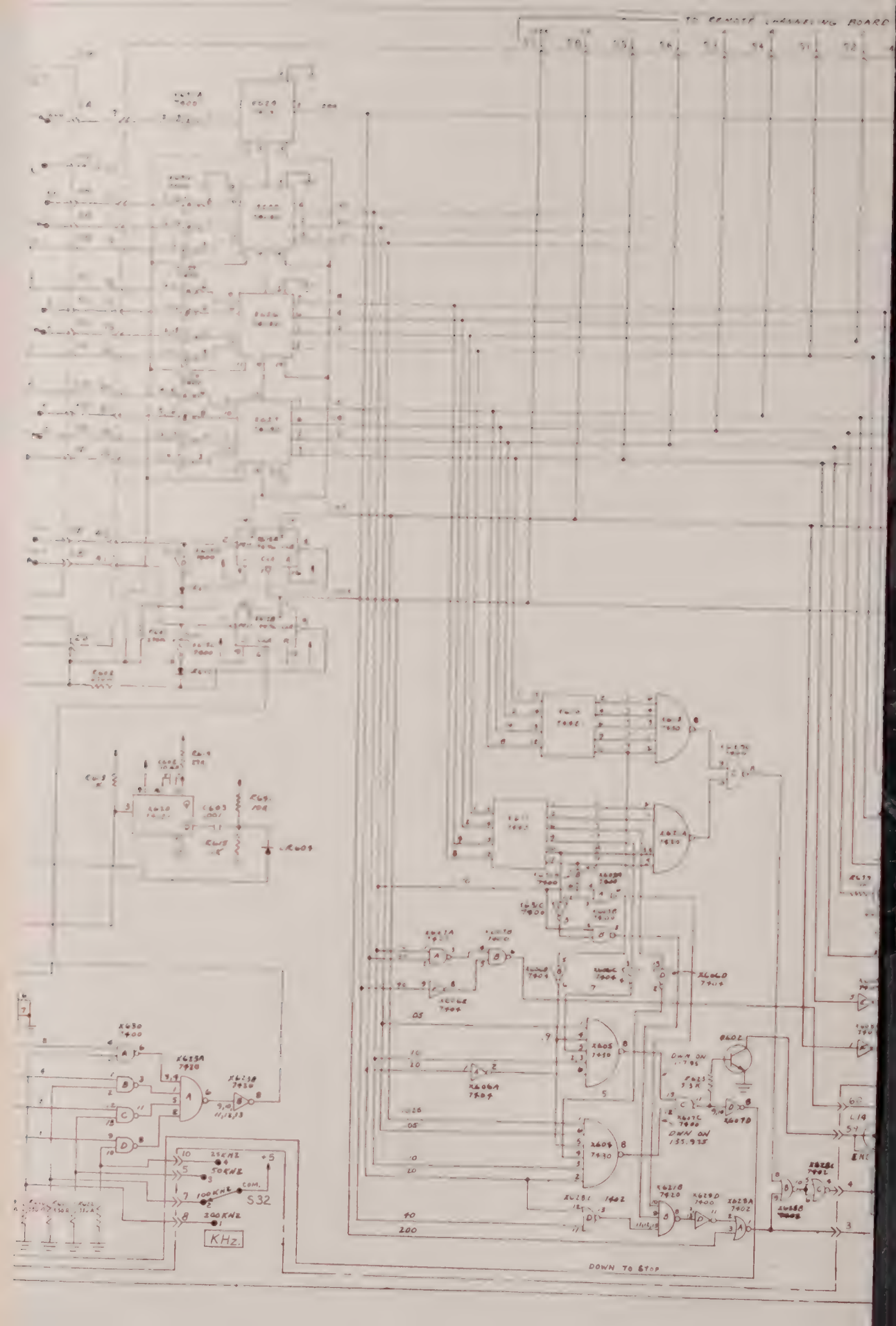
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

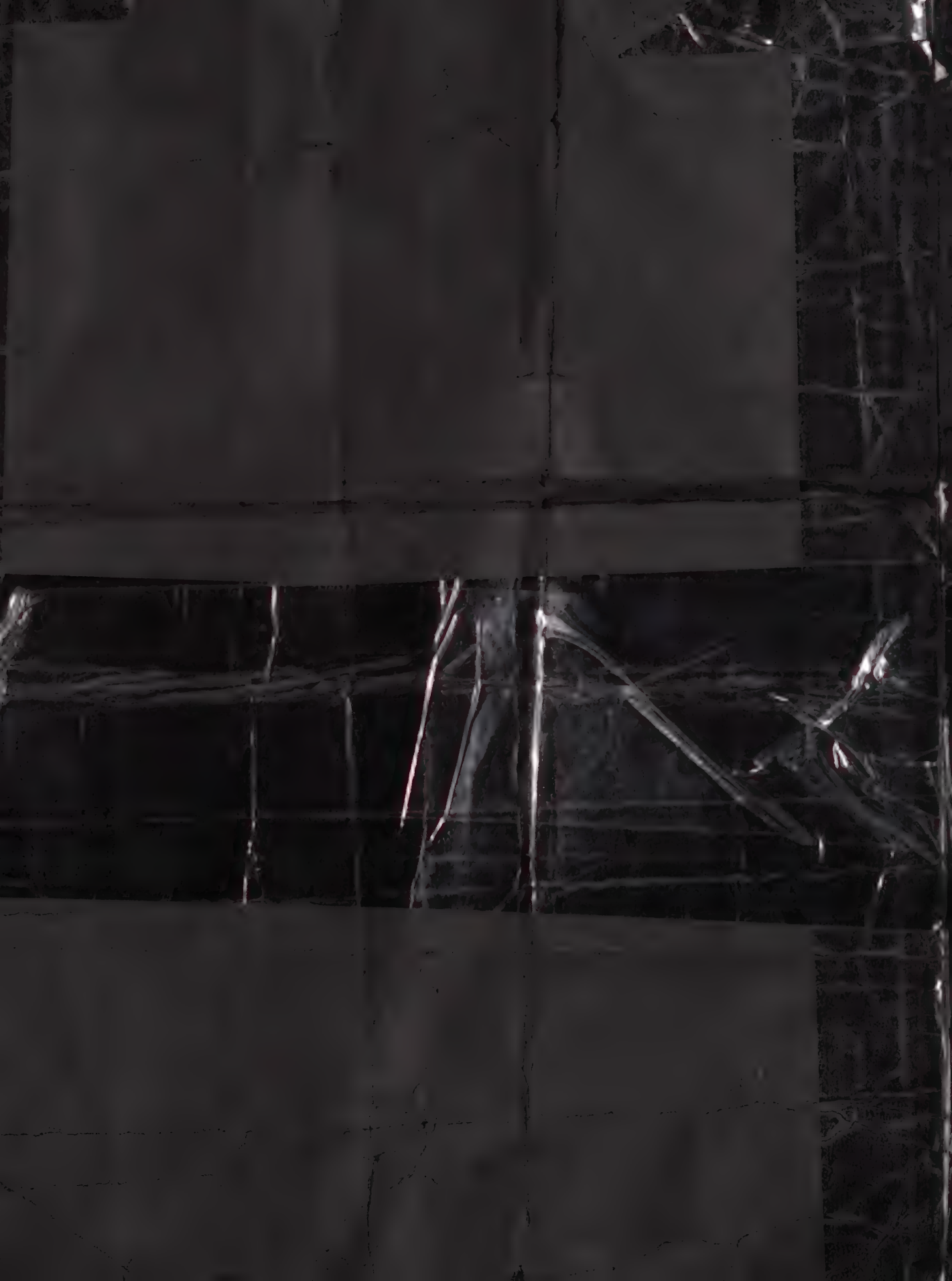
TITLE
REMOTE CHANNELING BOARD - MECH. LAYOUT NAV-750 PC-7

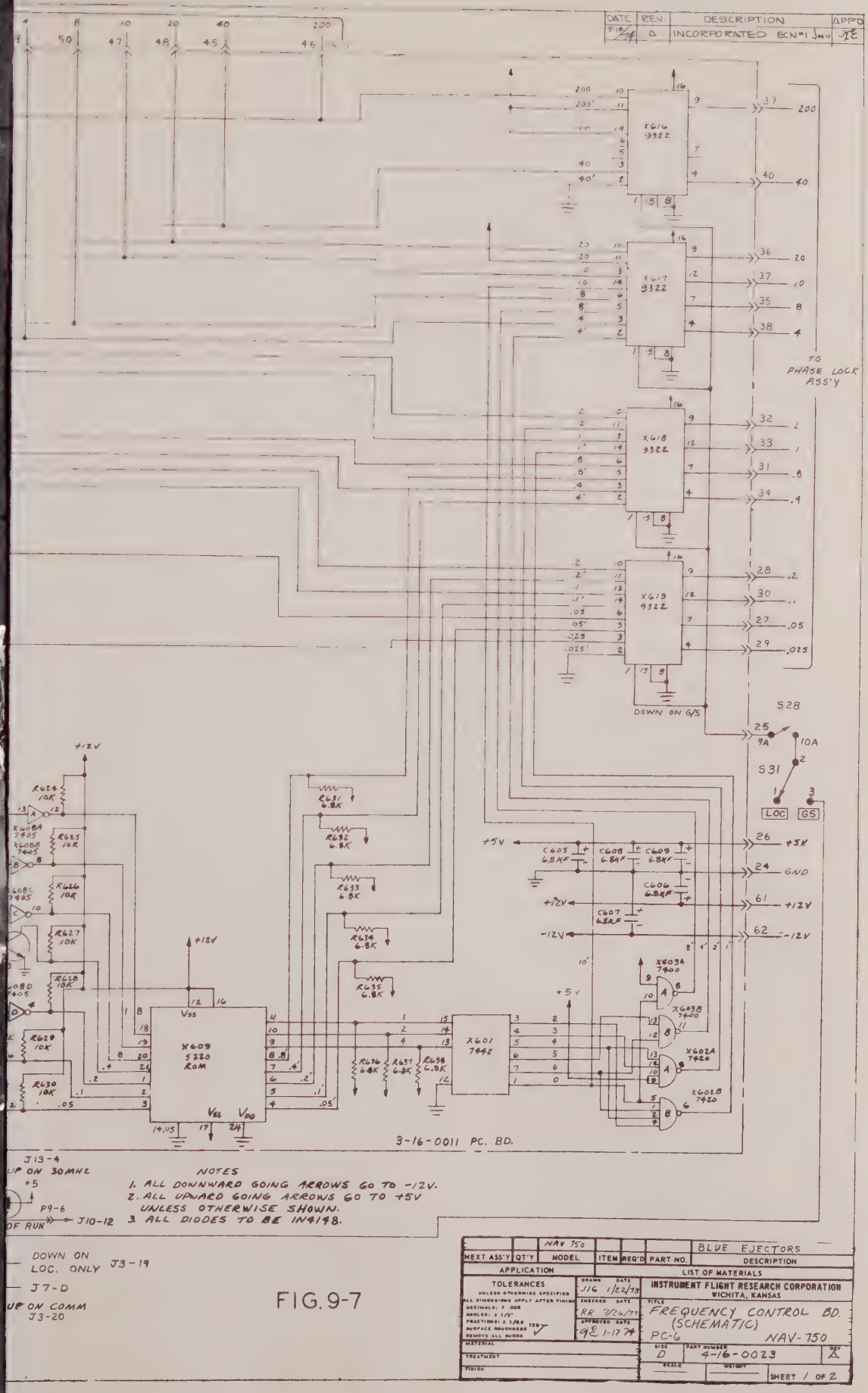
MATERIAL
TREATMENT
FINISH

SIZE — PART NUMBER 3-16-0018 — REV
SCALE — WEIGHT — SHEET 2 OF 2


LOGIC PACK
GND
VCC
7400 — 7 — 14
7402 — 7 — 14
7404 — 7 — 14
7405 — 7 — 14
7420 — 7 — 14
7430 — 7 — 14
7442 — 8 — 16
7473 — 11 — 4
7476 — 13 — 5
7490 — 10 — 5
74121 — 7 — 14
74190 — 8 — 16
74191 — 8 — 16
9322 — 8 — 16
FREQUENCY MHz.
J28
S28-INPUT SWITCH COMMON
1A
10A
S31-2
1B
COM.
1C
COM.
1D
COM.
1E
COM.
SPK. VOL. R12-3
SPK. OUT J1-21
S29B
L9
AUTO
+5
S29A
MANUAL
CHANNELING
INC RATE CW
INVERSE LOG 250K R11
R603 680Ω
R604 270Ω
R605 270Ω
X615A 7400
X615B 7400
R607 10K
+12V
X635 MC1709CG
REMOTE CHANNELING (REAR PANEL) J10-6
P9-22
STEP
S33
TO SPKR CKT J1-Y
C601 150MF
R606 330K
R608 10K
R609 18K
R610 470Ω
R611 1.5KΩ
R612 330Ω
X631C 7400
X622 7473
X614 7490
R639 220Ω
R616 10K
CR605
C609 .1MF MYLAR
Q601 2N3646
R618 680Ω
X623A 7400
X623B 7400
R617 220Ω
STOP AUTO LINE

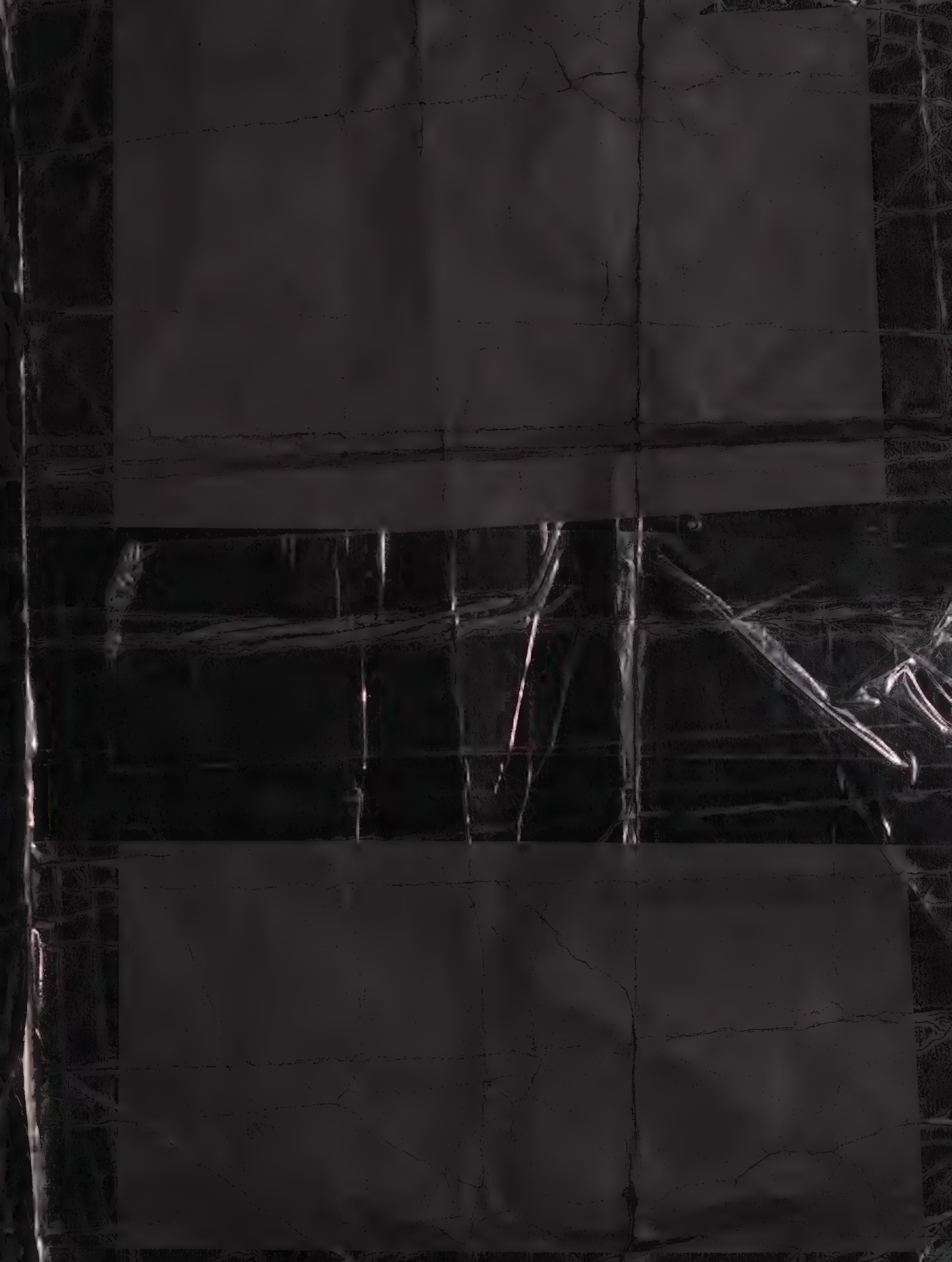

TO REMOTE CHANNELING BOARD
DOWN TO STOP
25KHZ
50KHZ
100KHZ
200KHZ
COM.
S32
KHz.
DWN ON
DWN ON
135.935
L14
ENC





DATE | REV. | DESCRIPTION | APP'D
A | INCORPORATED ECN#1 JNU
X616 9322
X617 9322
X618 9322
X619 9322
TO PHASE LOCK ASS'Y
DOWN ON G/S
S28
S31
LOC
GS
+5V
GND
+12V
-12V
X609 5220 ROM
X601 7442
X603A 7400
X603B 7400
X602A 7420
X602B 7420
3-16-0011 PC. BD.
J13-4
UP ON 30MHZ
P9-6
J10-12
OF RUN
DOWN ON LOC. ONLY J3-19
J7-D
UP ON COMM J3-20
NOTES
1. ALL DOWNWARD GOING ARROWS GO TO -12V.
2. ALL UPWARD GOING ARROWS GO TO +5V UNLESS OTHERWISE SHOWN.
3. ALL DIODES TO BE IN4148.
NAV 750
BLUE EJECTORS
NEXT ASS'Y | QT'Y | MODEL | ITEM | REQ'D | PART NO. | DESCRIPTION
APPLICATION
LIST OF MATERIALS
TOLERANCES
DRAWN JIG 1/22/73
CHECKED RR 7/26/73
APPROVED 9E 1-17-74
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS
TITLE FREQUENCY CONTROL BD. (SCHEMATIC)
PC-6 NAV-750
SIZE D
PART NUMBER 4-16-0023
REV A
SHEET 1 OF 2

FIG. 9-7



DATE	REV	CHANGE	APP'D

	CHANNELING RATE	32	2 MHZ
	REMOTE CHANNEL ADVANCE	33	1 MHZ
	UP ON COMM	34	4 MHZ
	DOWN ON LOCALIZER ONLY	35	8 MHZ
	50 KHZ	36	20 MHZ
	SPEAKER CKT.	37	10 MHZ
	100 KHZ	38	4 MHZ
	200 KHZ	39	200 MHZ
	200 MHZ	40	40 MHZ
	KHZ	41	025 MHZ
	20 MHZ	42	05 MHZ
18	+5V ON MEMORY	43	
	40 MHZ	44	
	10 MHZ	45	40 MHZ
	2 MHZ	46	200 MHZ
	MHZ	47	10 MHZ
	4 MHZ	48	20 MHZ
	8 MHZ	49	4 MHZ
	1 MHZ		8 MHZ
	.8 MHZ	51	1 MHZ
	4 MHZ	52	2 MHZ
	2 MHZ	53	4 MHZ
	INPUT SW. COMMON	54	.8 MHZ
	GND	55	.1 MHZ
	GND FOR GS	56	.2 MHZ
	+5V	57	025 MHZ
	05 MHZ	58	.05 MHZ
	.2 MHZ	59	END OF RUN LIGHT
	.025 MHZ	60	UP ON 30 MHZ
	1 MHZ	61	+12V
	.8 MHZ	62	-12V

FIG. 9-8

		NAV-750				BLANK EJECTORS
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION						LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 V
REMOVE ALL BURRS

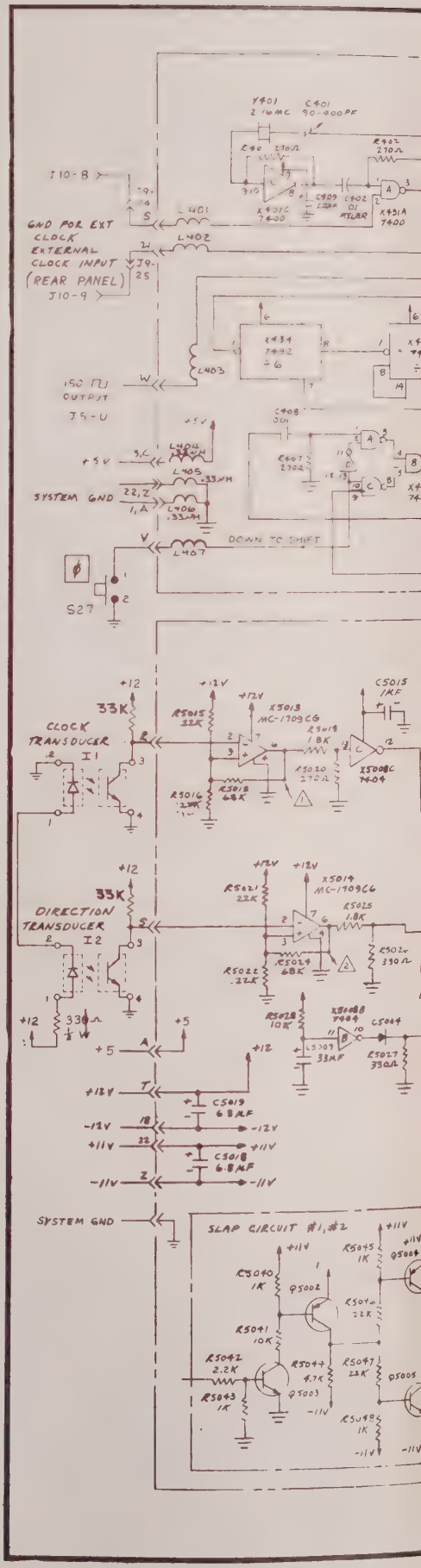
DRAWN JIG 7/7/73
CHECKED HK 7/23/73
APPROVED QE 1-10-74

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

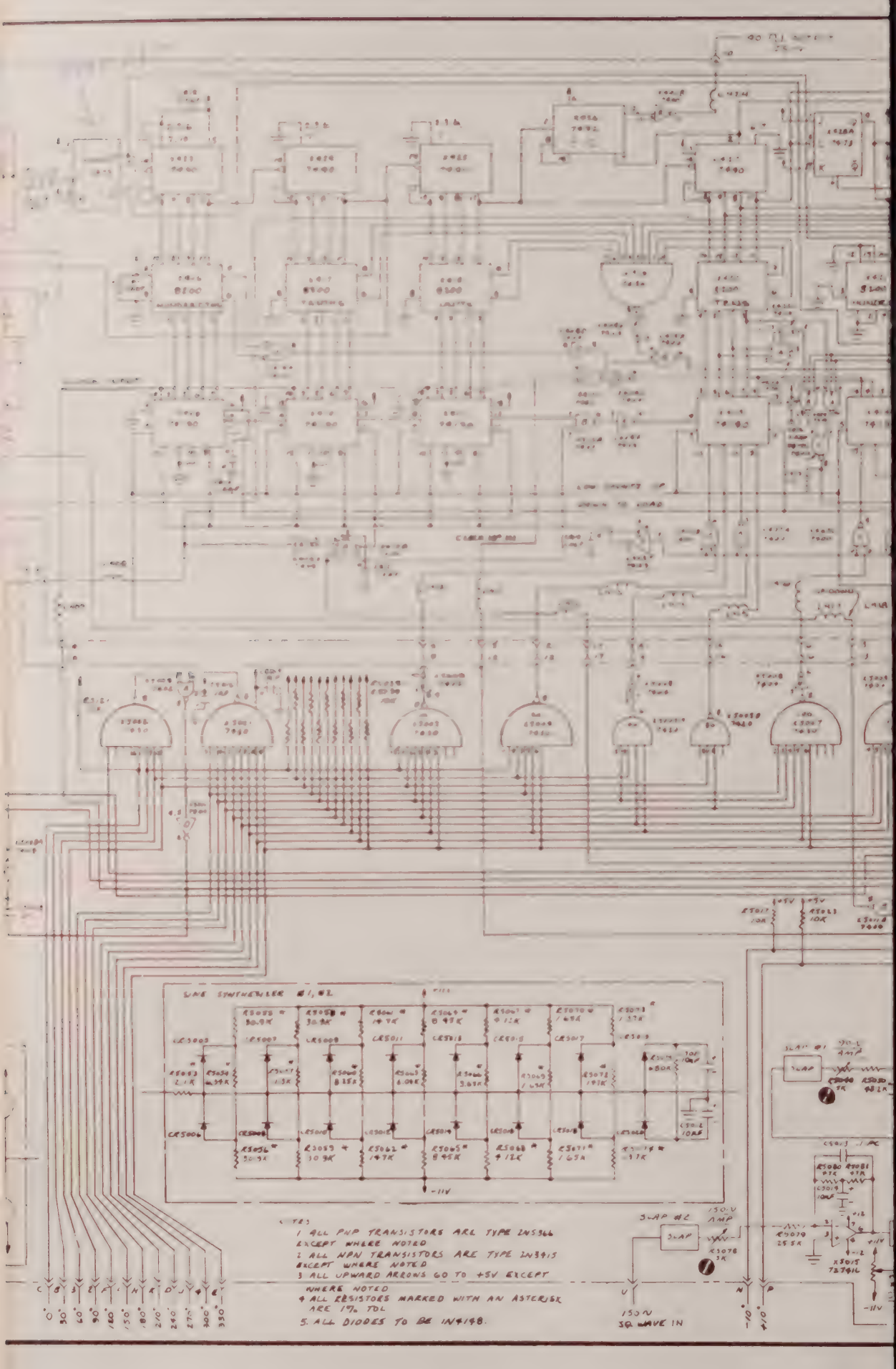
TITLE
FREQ. CONTROL BD.
MECH. LAYOUT
NAV-750 PC-6

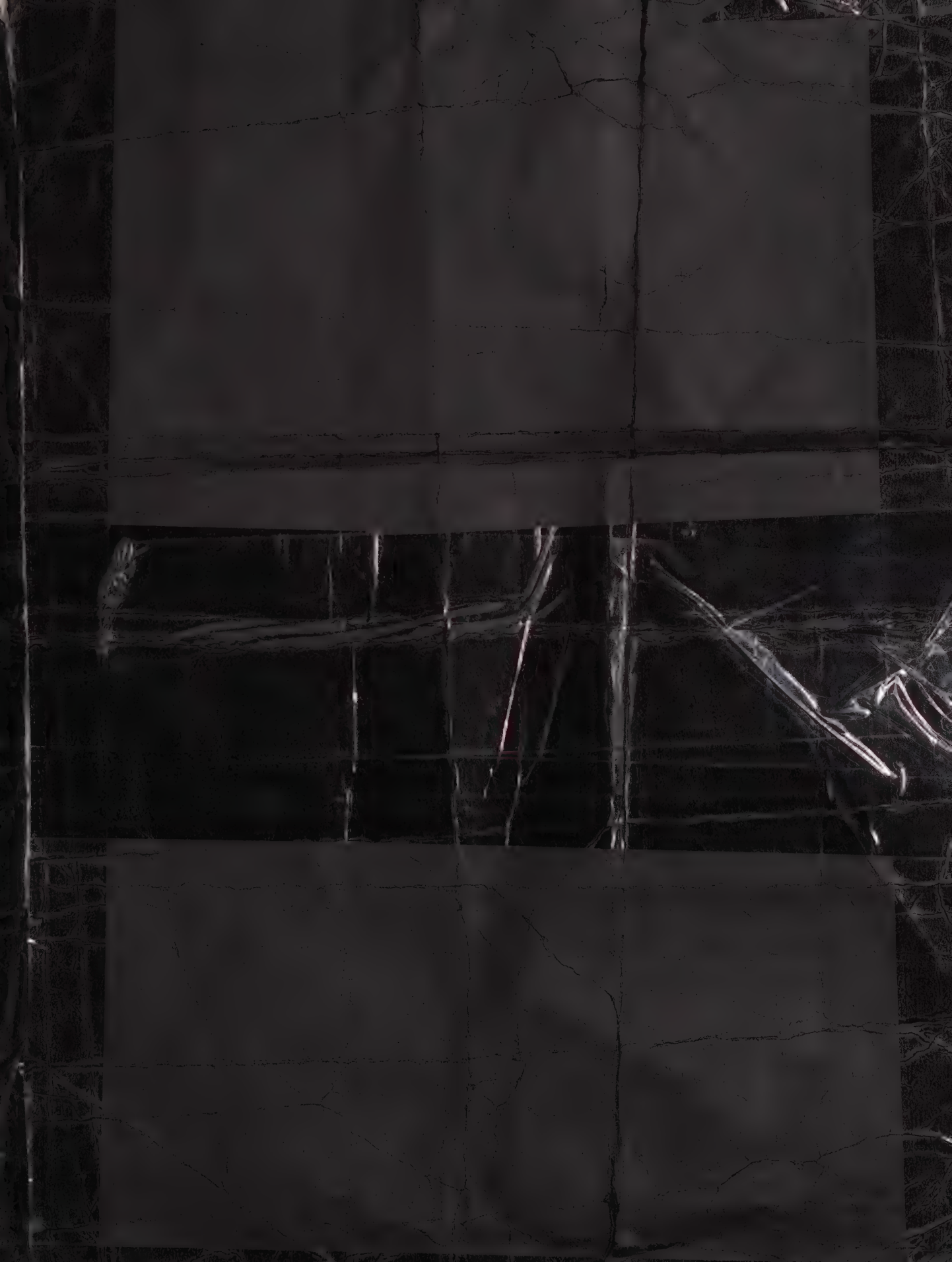
MATERIAL
TREATMENT
FINISH

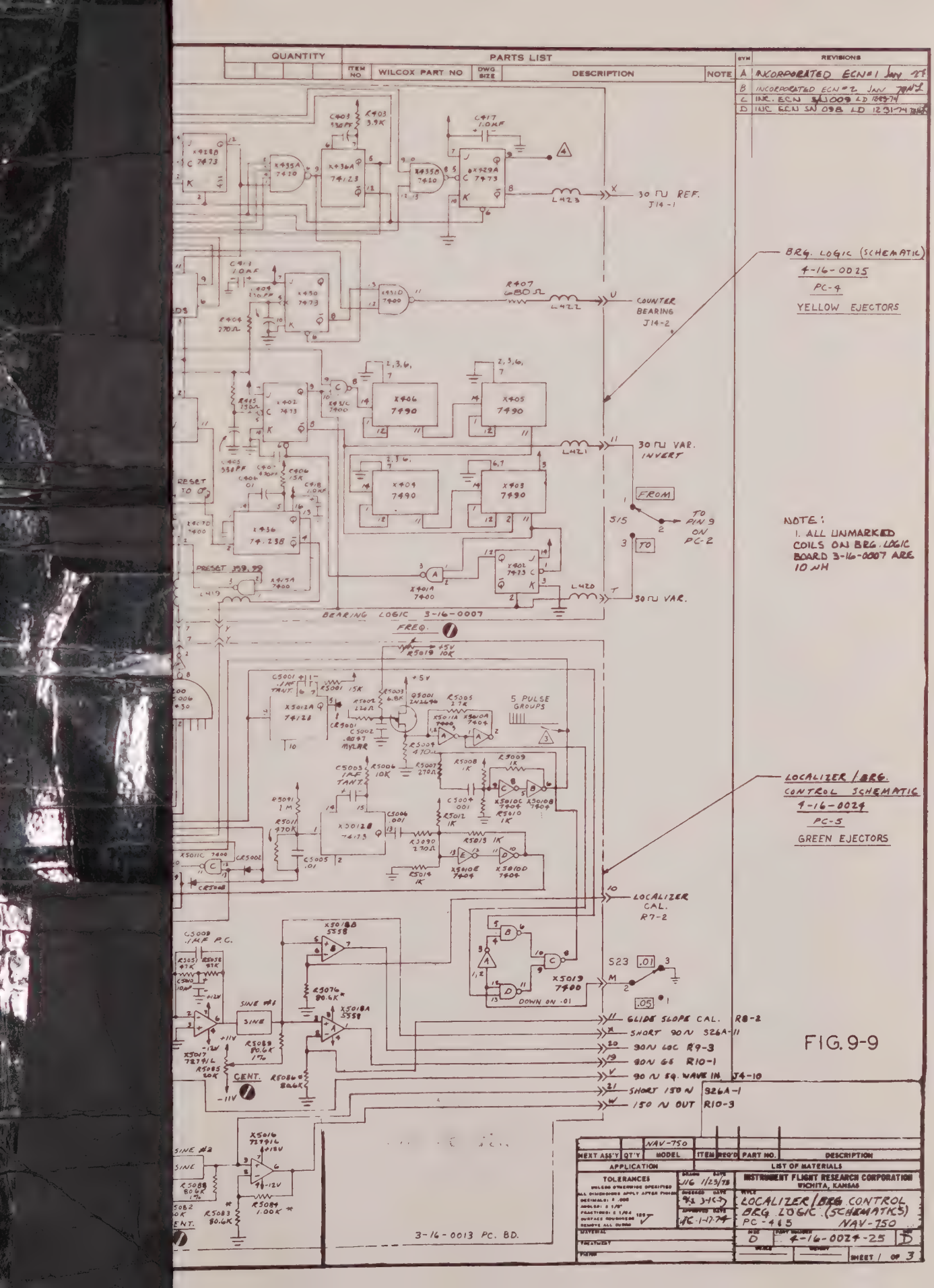
SIZE C | PART NUMBER 3-16-0023 | REV
SCALE 1:1 | WEIGHT | SHEET 2 OF 2



Y401
2.16MC
C401
90-400PF
R402
270Ω
J10-8
GND FOR EXT
CLOCK
EXTERNAL
CLOCK INPUT
(REAR PANEL)
J10-9
L401
L402
J9-25
X431A
7400
X434
7492
÷6
L403
150 ⊓⊔
OUTPUT
J5-U
+5V
L404
L405
.33μH
SYSTEM GND
L406
.33μH
C408
.001
R407
270Ω
DOWN TO SHIFT
L407
S27
CLOCK
TRANSDUCER
I1
33K
R5015
22K
X5013
MC-1709CG
R5019
1.8K
R5020
270Ω
R5016
R5018
68K
C5015
1μF
X5008C
7404
DIRECTION
TRANSDUCER
I2
R5021
22K
X5014
MC-1709CG
R5025
1.8K
R5024
68K
R5022
.22K
R5028
10K
X5008B
7404
C5004
C5007
33μF
R5027
330Ω
+12
330Ω
+5
+12V
-12V
+11V
-11V
C5019
6.8μF
C5018
6.8μF
SYSTEM GND
SLAP CIRCUIT #1, #2
R5040
1K
Q5002
R5041
10K
R5042
2.2K
R5043
1K
R5044
4.7K
Q5003
R5045
1K
R5046
22K
R5047
22K
Q5005
R5048
1K


SINE SYNTHESIZER #1, #2
NOTES
1 ALL PNP TRANSISTORS ARE TYPE 2N5966 EXCEPT WHERE NOTED
2 ALL NPN TRANSISTORS ARE TYPE 2N3415 EXCEPT WHERE NOTED
3 ALL UPWARD ARROWS GO TO +5V EXCEPT WHERE NOTED
4 ALL RESISTORS MARKED WITH AN ASTERISK ARE 1% TOL
5. ALL DIODES TO BE IN4148.
150 V SQ WAVE IN
SLAVE #1
SLAVE #2
150-V AMP
-11V




QUANTITY
PARTS LIST
ITEM NO
WILCOX PART NO
DWG SIZE
DESCRIPTION
NOTE
SYM
REVISIONS
A INCORPORATED ECN#1 JAN 74
B INCORPORATED ECN#2 JAN 74
C INC. ECN SN 009 LD 1-8-74
D INC ECN SN 098 LD 12-31-74
30 Ω REF. J14-1
COUNTER BEARING J14-2
30 Ω VAR. INVERT
30 Ω VAR.
FROM
TO PIN 9 ON PC-2
BEARING LOGIC 3-16-0007
FREQ.
5 PULSE GROUPS
LOCALIZER CAL. R7-2
GLIDE SLOPE CAL. R8-2
SHORT 90 Ω S26A-11
90 Ω LOC R9-3
90 Ω GS R10-1
90 Ω SQ. WAVE IN J4-10
SHORT 150 Ω S26A-1
150 Ω OUT R10-3
3-16-0013 PC. BD.
BRG. LOGIC (SCHEMATIC)
4-16-0025
PC-4
YELLOW EJECTORS
LOCALIZER/BRG. CONTROL SCHEMATIC
4-16-0024
PC-5
GREEN EJECTORS
NOTE:
1. ALL UNMARKED COILS ON BRG. LOGIC BOARD 3-16-0007 ARE 10 MH
FIG. 9-9
NAV-750
NEXT ASS'Y
QT'Y
MODEL
ITEM REQ'D
PART NO.
DESCRIPTION
APPLICATION
LIST OF MATERIALS
TOLERANCES
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS
LOCALIZER/BRG CONTROL BRG LOGIC (SCHEMATICS)
PC-465
NAV-750
4-16-0024-25
D
SHEET 1 OF 3

C401
PIN 1 ON TOP
PIN A ON BOTTOM

DATE	REV	CHANGE	APP'D

1	SYSTEM GND
A	SYSTEM GND
2	
B	
3	+5V IN
C	+5V IN
4	
D	
5	DOWN TO LOAD
E	
6	100° IN
F	
7	200° IN
H	
8	40° IN
J	
9	10° IN
K	
10	90 HZ OUTPUT
L	
11	30 Hz VAR. INVERT
M	

12	20° IN
N	
13	UP-DOWN
P	
14	CLOCK INPUT
R	
15	CLOCK 10° IN
S	GND FOR EXT CLOCK
16	80° IN
T	30 Hz. VAR. OUTPUT
17	ENABLE INPUT
U	COUNTER BEARING
18	
V	GND TO SHIFT PHASE
19	
W	150 HZ OUTPUT
20	
X	30 HZ REF OUTPUT
21	EXT. CLOCK INPUT
Y	360° CKT
22	SYSTEM GND
Z	SYSTEM GND

FIG. 9-10

		NAV-750				YELLOW EJECTORS
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION			LIST OF MATERIALS			

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 V
REMOVE ALL BURRS

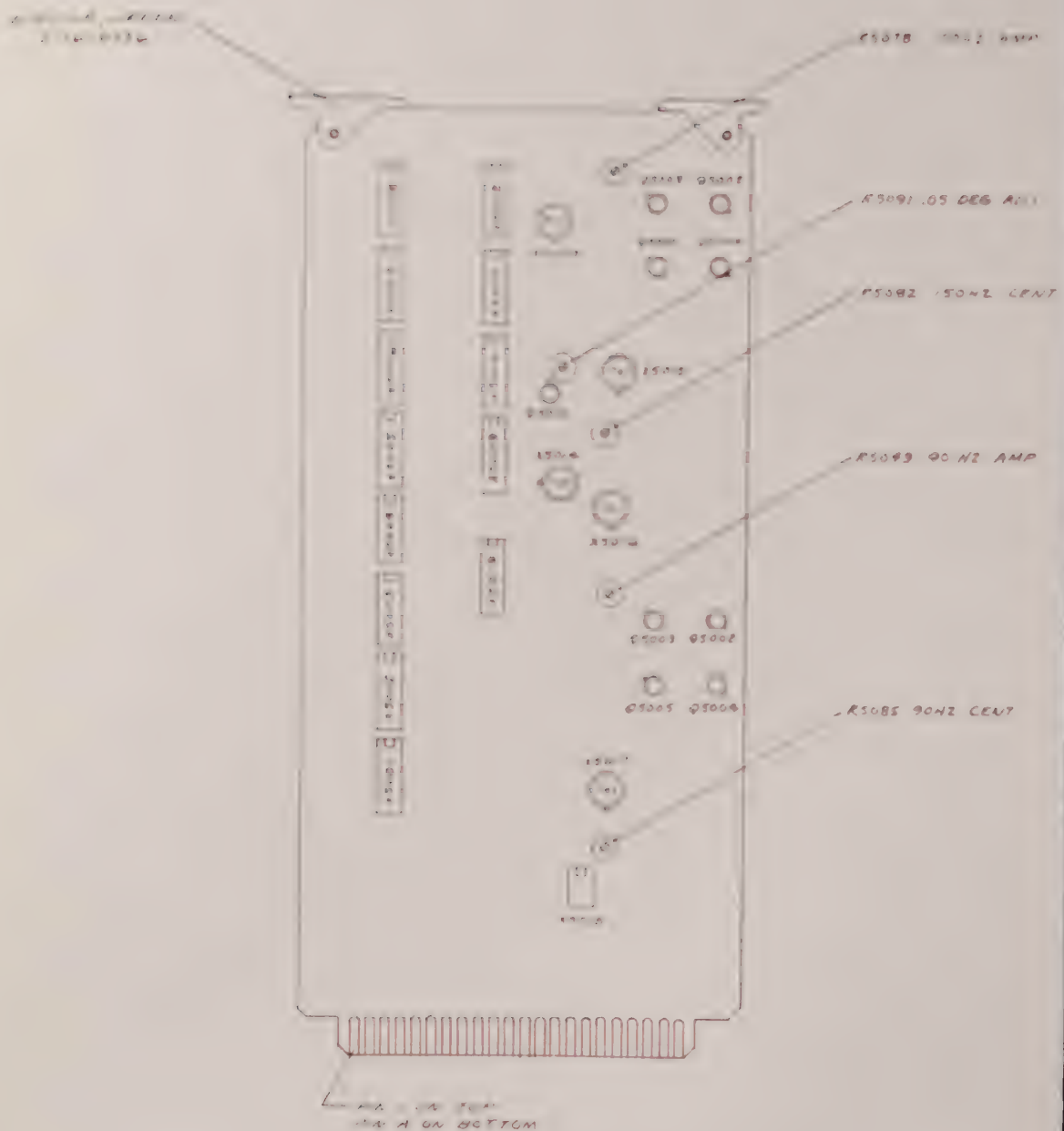
MATERIAL
TREATMENT
FINISH

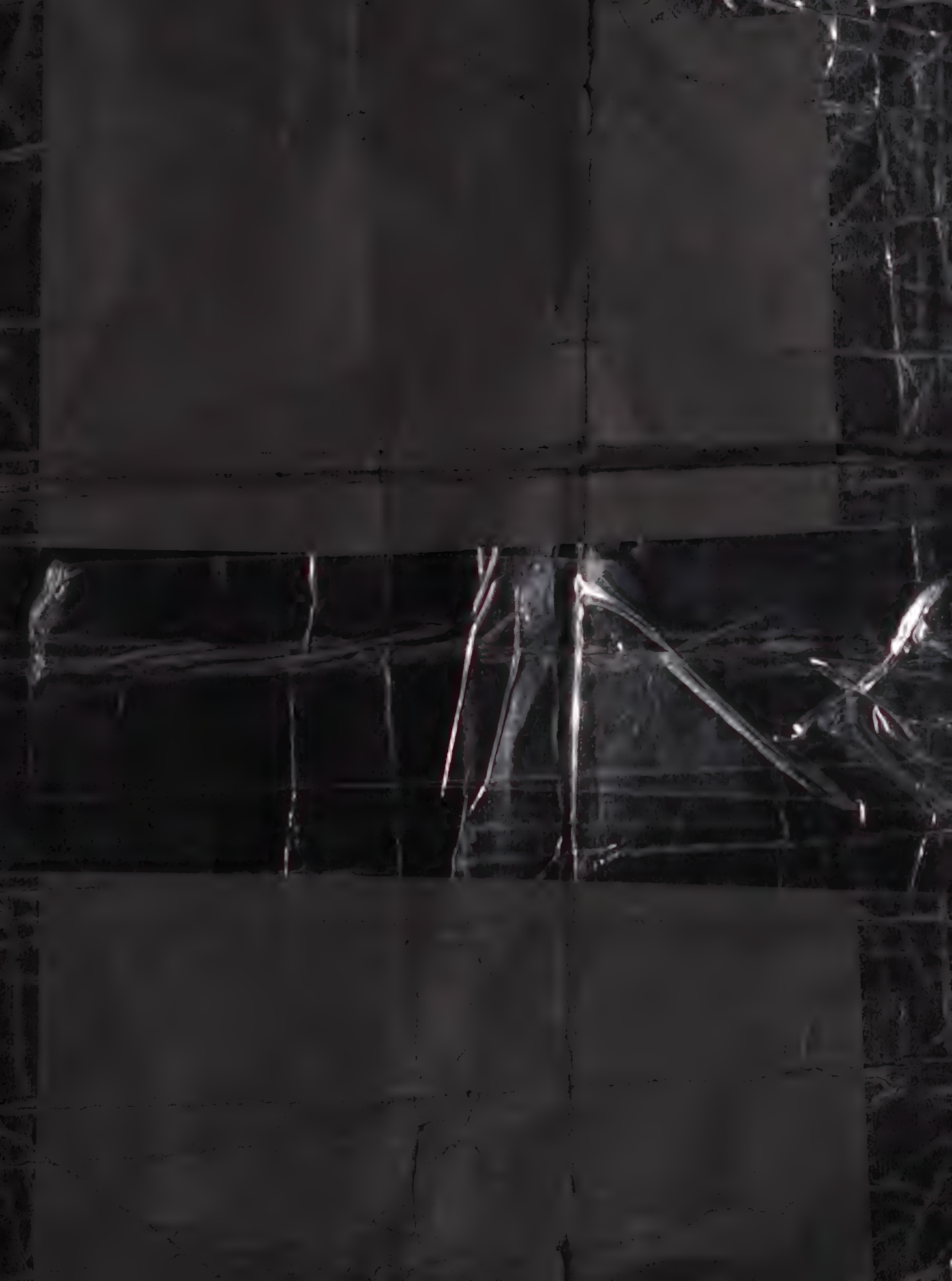
DRAWN JIG 4/29/73
CHECKED KR 7/25/73
APPROVED VE 1-17-74

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE
BEARING LOGIC BD
MECH. LAYOUT
NAV-750 PC-9

SIZE C | PART NUMBER 3-16-0025 | REV
SCALE 1:1 | WEIGHT
SHEET 2 OF 3


R5091 .05 DEG ADJ
R5092 150HZ CENT
R5093 90 HZ AMP
R5085 90HZ CENT



DATE	REV	CHANGE	APP'D

1	SYSTEM GND
A	+5V
2	90° SW IN
B	30° SW. IN
3	60° SW. IN
C	0° SW IN
4	300° SW IN
D	240° SW. IN
5	DOWN TO LOAD
E	330° SW. IN
6	100° OUT
F	120° SW. IN
7	200° OUT
H	180° SW. IN
8	40° OUT
J	270° SW. IN
9	10° OUT
K	210° SW. IN
10	LOCALIZER CAL.
L	150° SW. IN
11	GLIDE SLOPE CAL.
M	.01/.05 PULL

12	20° OUT
N	-10° SW IN
13	UP - DOWN
P	+10° SW. IN
14	CLOCK OUTPUT
R	TRANSDUCER
15	10° CLOCK
S	TRANSDUCER 2
16	80° OUT
T	+12V IN
17	10° ENABLE OUTPUT
U	150 Hz. SQ. WAVE IN
18	-12V IN
V	90 HZ SQ WAVE IN
19	90 HZ GS OUT
W	150 HZ OUT
20	90 HZ LOC OUT
X	SHORT 90 HZ
21	SHORT 150 HZ
Y	0-360° CKT.
22	+11V IN
Z	-11V IN

FIG. 9-12

		NAV-750				GREEN EJECTORS
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION			LIST OF MATERIALS			

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

DRAWN JJG 4/21/73
CHECKED
APPROVED 1-1774

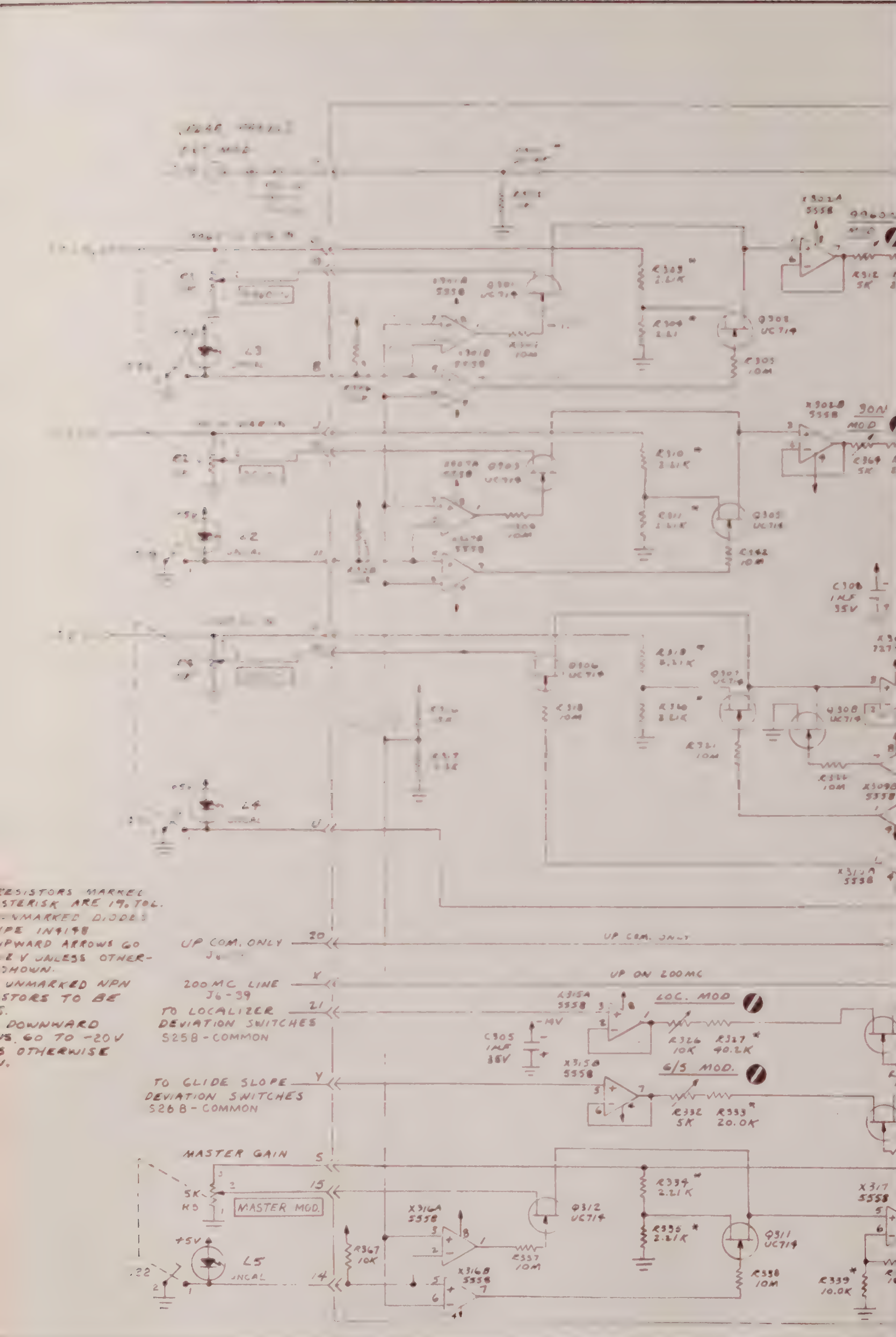
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE
LOCALIZER/BRG CONTROL
MECH LAYOUT
NAV-750 PC-5

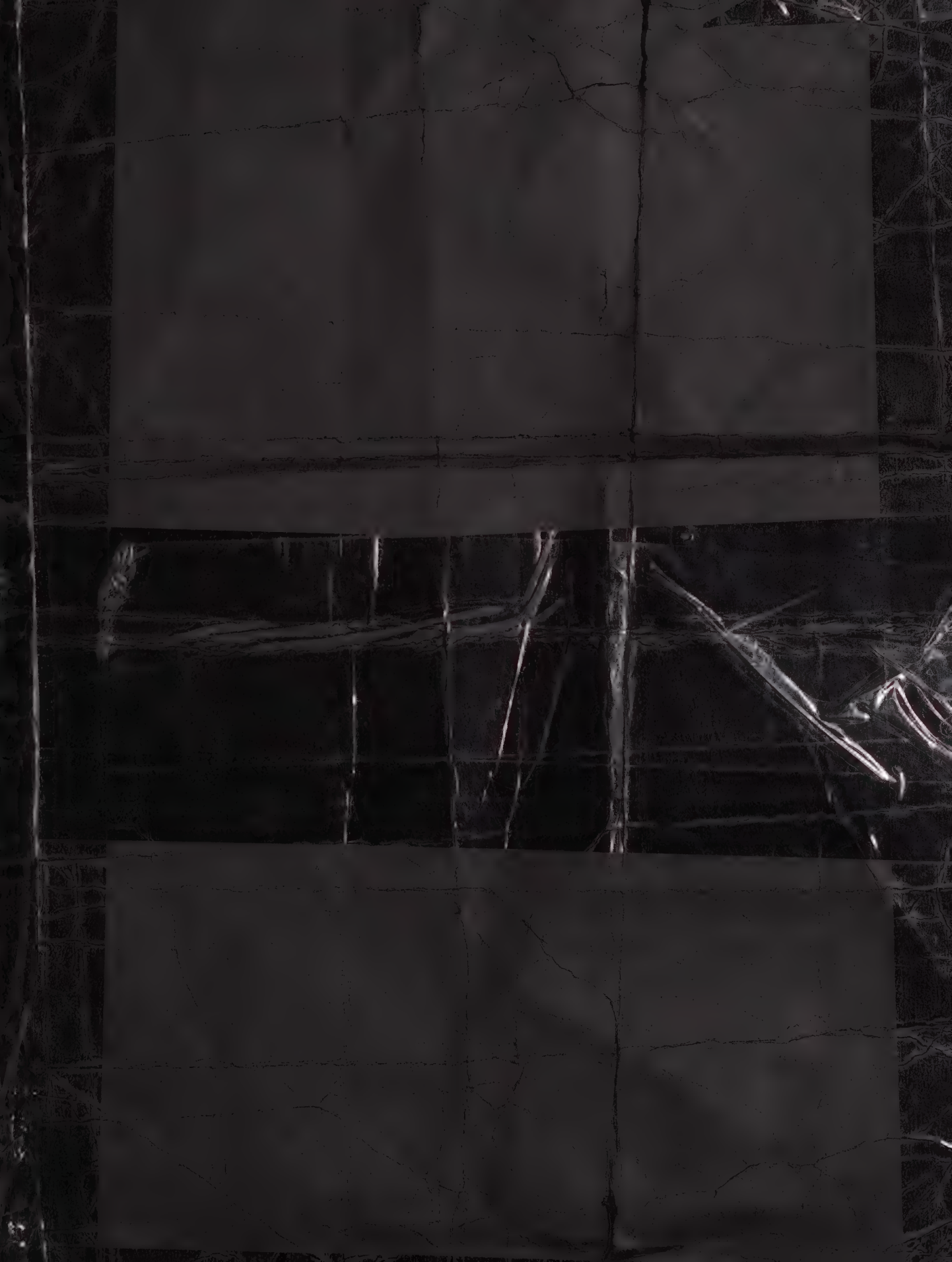
MATERIAL
TREATMENT
FINISH

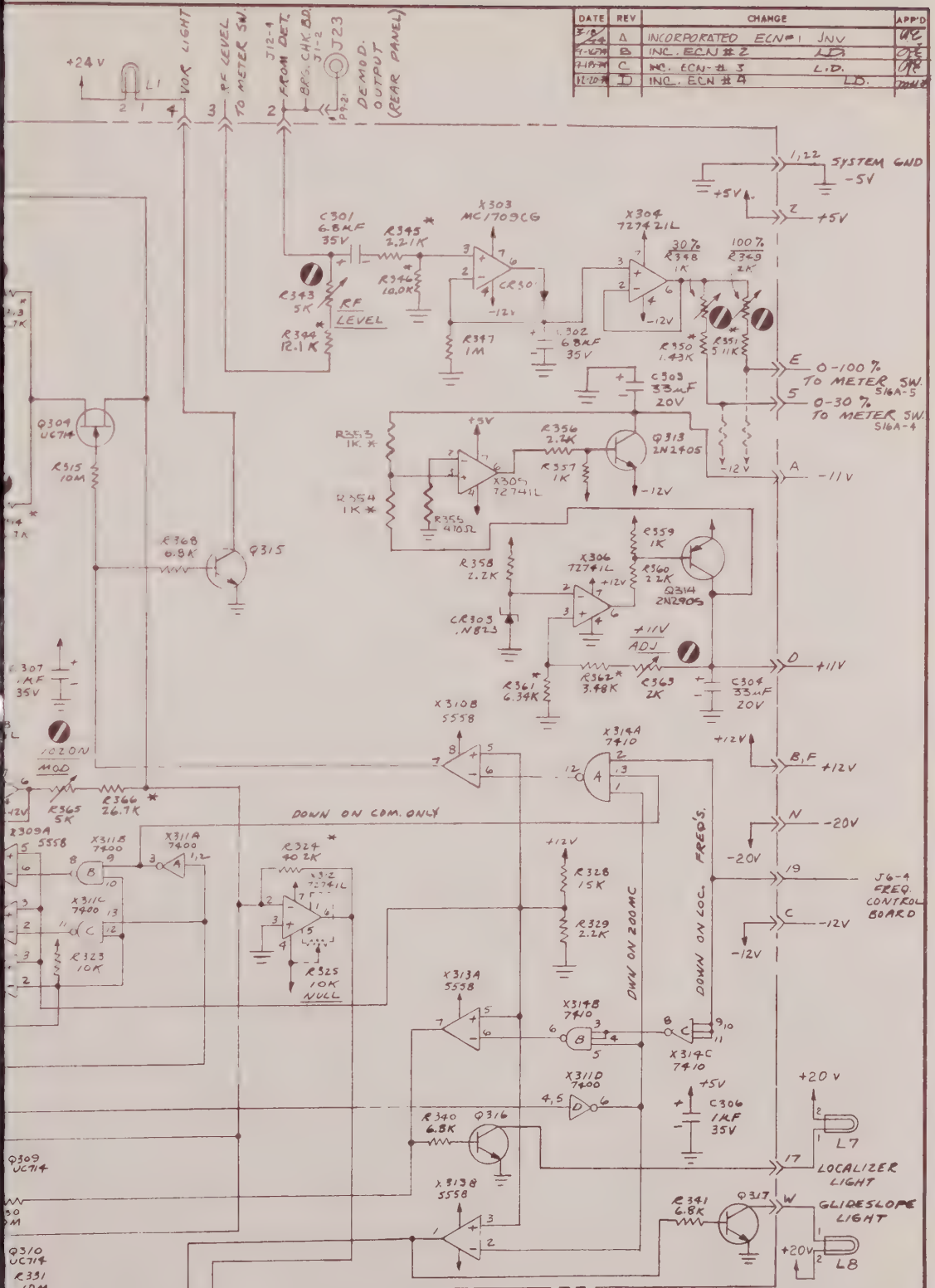
SIZE C | PART NUMBER 3-16-0024 | REV
SCALE 1:1 | WEIGHT | SHEET 3 OF 3

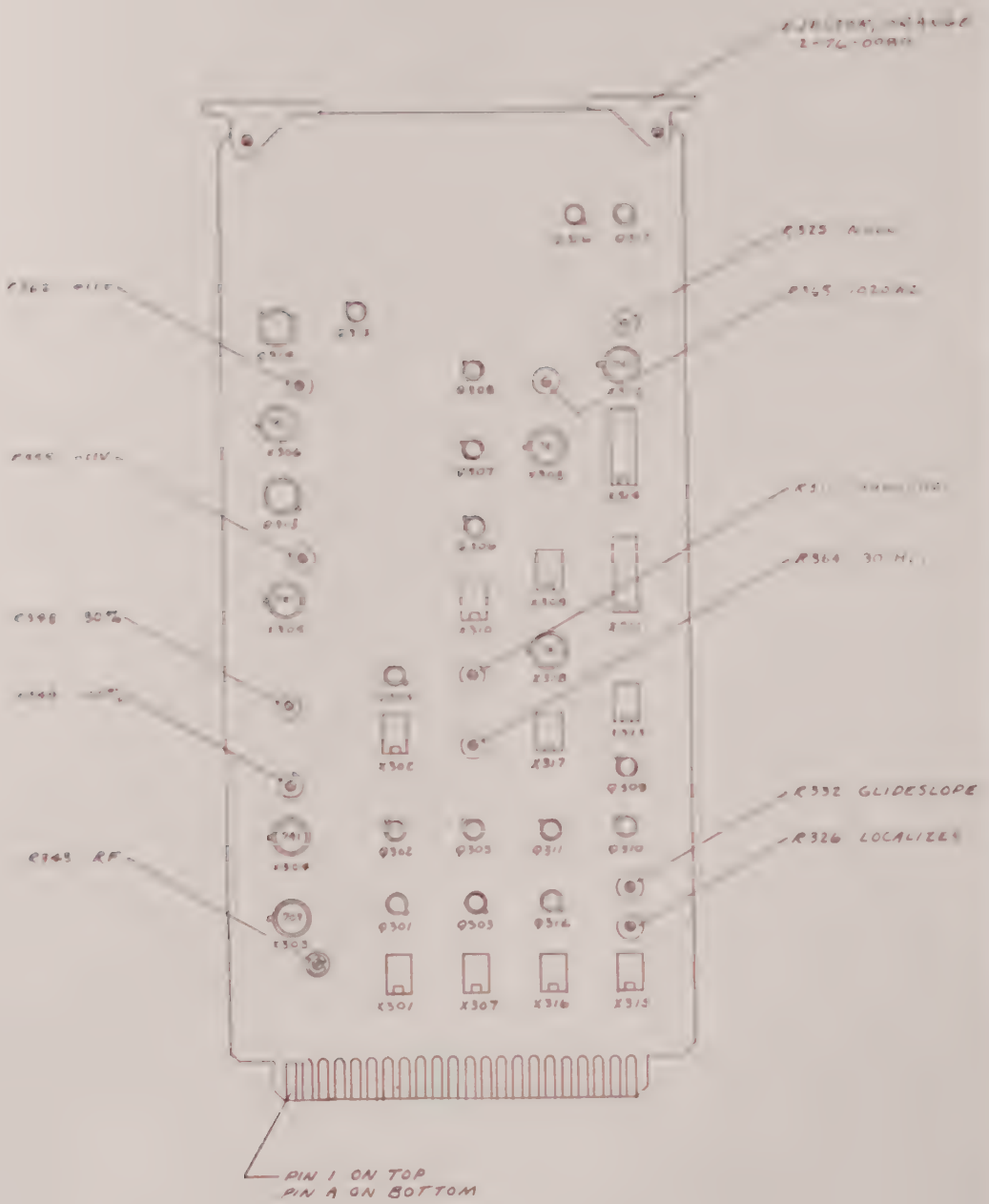
NOTES
1. ALL
WITH
2. ALL
ARE T
3. ALL
TO
.WISE
4. ALL
TRANS.
2N391
5. ALL
ARROW
UNLES
SHOWN

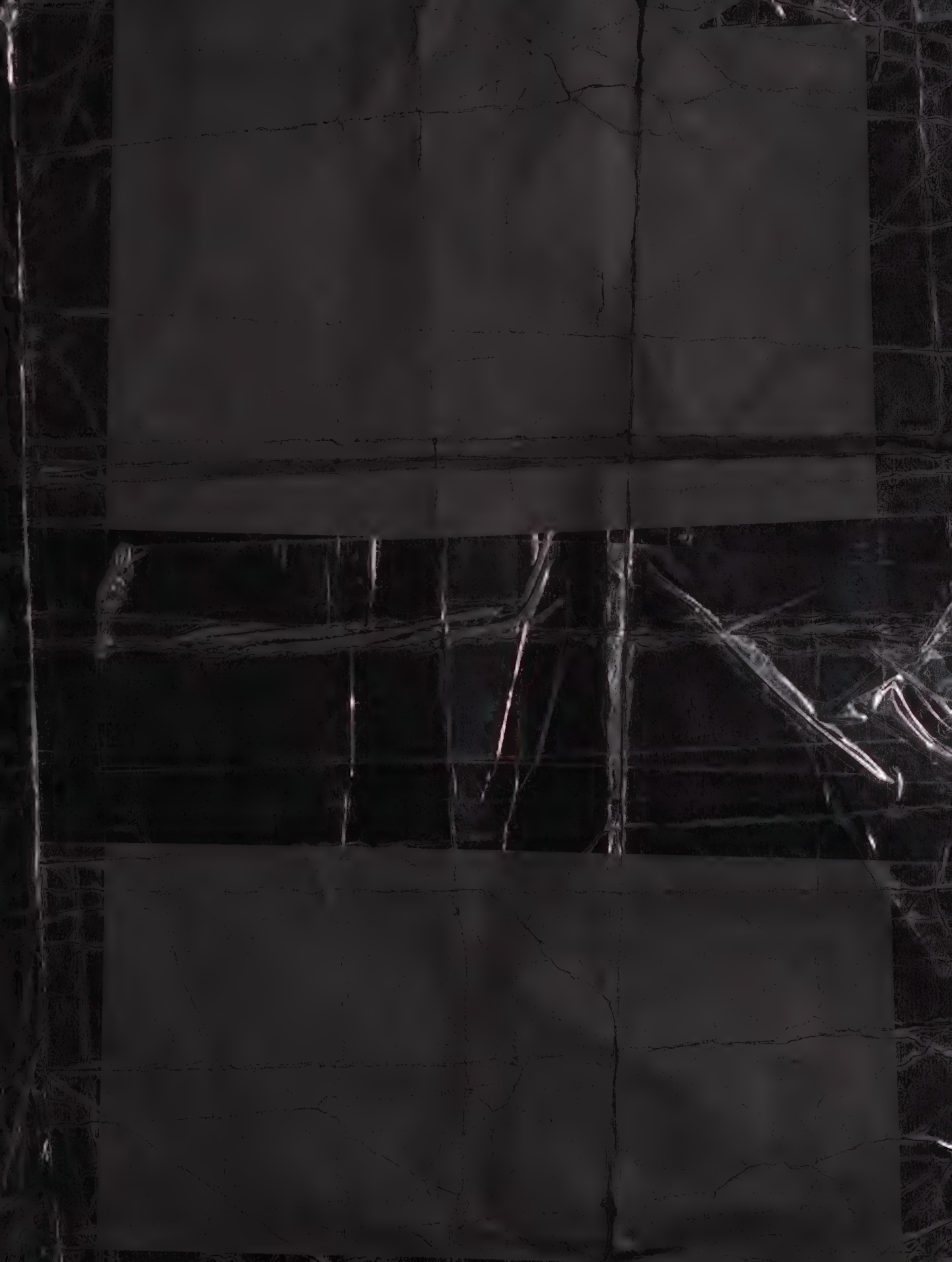


ESISTORS MARKED
STERISK ARE 1% TOL.
NMARKED DIODES
PE IN4148
PWARD ARROWS GO
V UNLESS OTHER-
HOWN.
UNMARKED NPN
STORS TO BE
DOWNWARD
S GO TO -20V
S OTHERWISE
UP COM. ONLY
200 MC LINE
J6-39
TO LOCALIZER
DEVIATION SWITCHES
S25B-COMMON
TO GLIDE SLOPE
DEVIATION SWITCHES
S26B-COMMON
MASTER GAIN
MASTER MOD.
UP COM. ONLY
UP ON 200MC
LOC. MOD
G/S MOD.
90Hz MOD
X315A 5558
X315B 5558
X316A 5558
X316B 5558
X317 5558
X302A 5558
X302B 5558
X309B 5558
X310A 5558
C305 1MF 35V
C308 1MF 35V
R326 10K
R327 40.2K
R332 5K
R333 20.0K
R334 2.21K
R335 2.21K
R337 10M
R338 10M
R339 10.0K
R367 10K
R303 2.21K
R304 2.21
R305 10M
R310 2.21K
R311 2.21K
R312 5K
R318 2.21K
R319 10M
R320 2.21K
R321 10M
R322 10M
R369 5K
Q301 UC714
Q302 UC714
Q303 UC714
Q305 UC714
Q306 UC714
Q307 UC714
Q308 UC714
Q311 UC714
Q312 UC714
L2
L3
L4
L5
UNCAL
+5V
5K
R5




DATE | REV | CHANGE | APP'D
A INCORPORATED ECN#1 JNV
B INC. ECN # 2 LD
C INC. ECN-# 3 L.D.
D INC. ECN #4 LD.
+24V
L1
VOR LIGHT
RF LEVEL TO METER SW.
J12-1 FROM DET.
BPS CHK BD J1-2
J23
DEMOD. OUTPUT (REAR PANEL)
1,22 SYSTEM GND -5V
+5V
Z +5V
C301 6.8MF 35V
R345 2.21K
X303 MC1709CG
R343 5K RF LEVEL
R344 12.1K
R346 10.0K
CR301
-12V
R347 1M
C302 6.8MF 35V
X304 727421L
30% R348 1K
100% R349 2K
R350 1.43K
R351 5.11K
C303 33MF 20V
E 0-100% TO METER SW. S16A-5
S 0-30% TO METER SW. S16A-4
Q309 UC714
R315 10M
R353 1K
R354 1K
R355 410Ω
X305 727421L
R356 2.2K
R357 1K
Q313 2N2405
A -11V
R368 6.8K
Q315
R358 2.2K
X306 727421L
R359 1K
R360 2.2K
Q314 2N2905
CR303 1N823
+11V ADJ
R361 6.34K
R362 3.48K
R363 2K
C304 33MF 20V
D +11V
C307 1MF 35V
OZON MOD
R365 5K
R366 26.7K
X308 5558
X314A 7410
+12V
B,F +12V
DOWN ON COM. ONLY
X309A 5558
X311B 7400
X311A 7400
X311C 7400
R323 10K
R324 40.2K
X312 727421L
R325 10K NULL
R326 15K
R329 2.2K
N -20V
-20V
19 J6-4 FREQ CONTROL BOARD
C -12V
-12V
DOWN ON 200MC
DOWN ON LOC. FREQ'S.
X313A 5558
X314B 7410
X314C 7410
X311D 7400
+5V
C306 1MF 35V
+20V
L7
17 LOCALIZER LIGHT
R340 6.8K
Q316
X313B 5558
R341 6.8K
Q317
W GLIDESLOPE LIGHT
+20V
L8
Q309 UC714
Q310 UC714
R331 10M
FIG.9-13
NAV-750
ORANGE EJECTORS
NEXT ASS'Y | QT'Y | MODEL | ITEM | REQ'D | PART NO. | DESCRIPTION
APPLICATION
LIST OF MATERIALS
TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS
REMOVE ALL BURRS
MATERIAL
TREATMENT
FINISH
DRAWN JIG 2/13/73
CHECKED RR 2/25/73
APPROVED 1-17-74
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS
TITLE
TONE SUMMATION BD. SCHEMATIC
NAV-750 -PC-3
SIZE C
PART NUMBER 3-16-0020
REV D
SCALE
WEIGHT
SHEET 1 OF 2
3-16-0017 PC. BD.
X318 727421L
18 TO MODULATOR J12-5
V
J21
19-18 TONE OUTPUT (REAR PANEL)


R332 GLIDESLOPE
R326 LOCALIZER
R343 RF
PIN 1 ON TOP
PIN A ON BOTTOM



DATE	REV	CHANGE	APP'D

1	GND
A	[illegible]
2	FROM DET.
B	112V [illegible]
3	RF LEVEL
C	12V [illegible]
4	VOR LIGHT
D	+11[illegible]
5	0-30 %
E	0-100 %
6	9960 HZ INPUT
F	+12V
7	EXT. MOD. INPUT
H	
8	9960 HZ LAMP SW.
J	30 HZ VAR INPUT
9	9960 HZ POT WIPER
K	
10	1020 HZ POT WIPER
L	1020 HZ INPUT
11	30HZ VAR LAMP SW.
M	

12	
N	[illegible]
13	30 HZ VAR POT WIPER
P	
14	MASTER GAIN LAMP SW
R	
15	MASTER GAIN POT WIPER
S	MASTER GAIN
16	
T	
17	LOCALIZER LAMP
U	1020 HZ LAMP SW
18	TO MODULATOR
V	TONES OUTPUT
19	GS-LOC (GND GS)
W	GLIDE SLOPE LAMP
20	UP COMM ONLY
X	200 MC LINE
21	LOCALIZER DEV. SWITCHES
Y	GLIDE SLOPE DEV. SWITCHES
22	GND
Z	+5V IN

FIG. 9-14

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	ORANGE EJECTORS DESCRIPTION
APPLICATION						LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 V
REMOVE ALL BURRS

MATERIAL
TREATMENT
FINISH

DRAWN VG 5-18-73
CHECKED RR 7/25/73
APPROVED VG 1-17-74

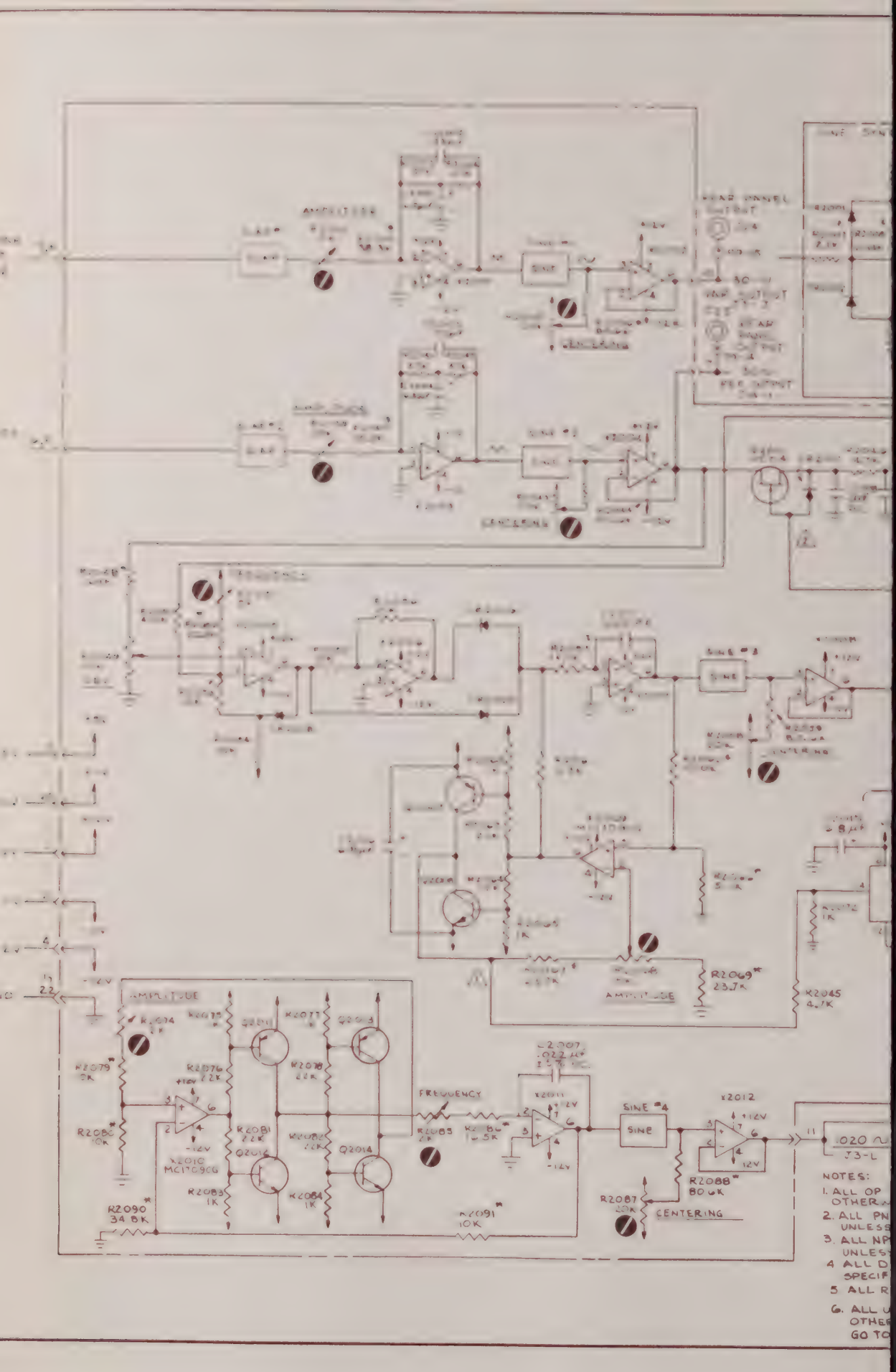
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: TONE SUMMATION BD MECH. LAYOUT NAV-750 PC-3

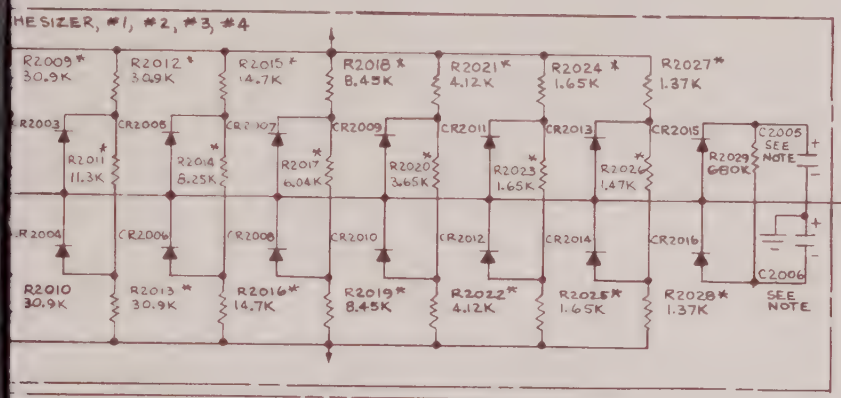
SIZE C | PART NUMBER 3-16-0020 | REV

SCALE 1:1 | WEIGHT | SHEET 2 OF [illegible]

30Ω
INPU
S15
30Ω
INPU
J4-X
SYS. G


AMPLITUDE
CENTERING
SINE #3
SINE
R2069*
23.7K
R2045
4.7K
AMPLITUDE
R2079*
R2080*
10K
R2076
22K
R2078
22K
R2081
22K
R2082
22K
Q2011
Q2013
Q2012
Q2014
R2083
1K
R2084
1K
X2010
MC1709CG
R2090*
34.8K
FREQUENCY
R2085
2K
X2011
SINE #4
SINE
X2012
R2088*
80.6K
R2087
20K
CENTERING
R2091*
10K
.020 ~
J3-L
NOTES:
1. ALL OP
OTHER
2. ALL PN
UNLESS
3. ALL NP
UNLESS
4 ALL D
SPECIF
5 ALL R
6. ALL U
OTHER
GO TO

DATE	REV	CHANGE	APP'D
4/24/74	A	INCORP ECN SER. 033 GLD	



NOTE

C2005 C2006	SINE CKT
15μf, 20V	# 1, #2
1μf, 35V	#3
6.8μf, 35V	#4

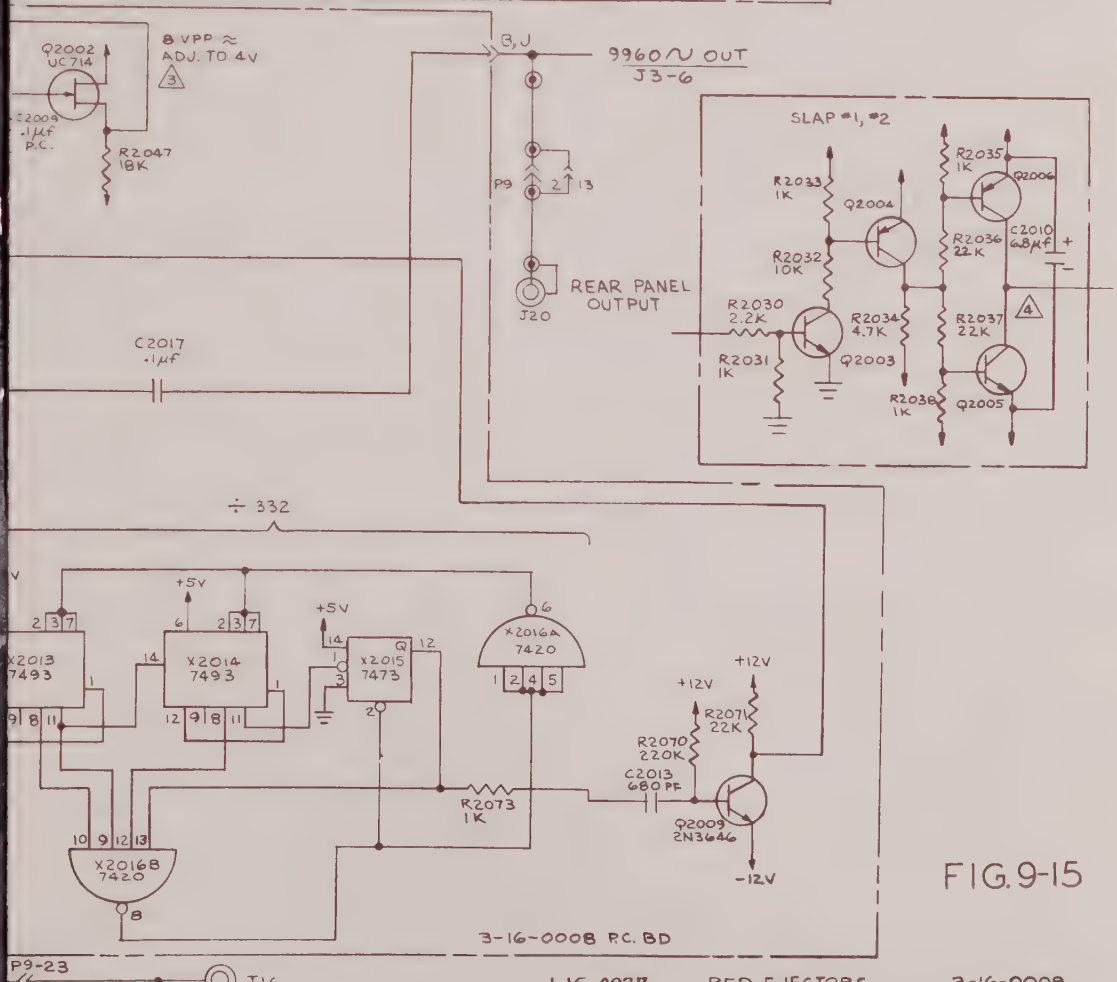


FIG. 9-15

P9-23 OUT

J16

J10-11

REAR PANEL OUTPUT

1-16-0027 PARTS LIST

RED EJECTORS

3-16-0008 ARTWORK

AMPS ARE SN72741L UNLESS ISE NOTED.
P TRANSISTORS ARE TYPE 2N5366 OTHERWISE SPECIFIED.
N TRANSISTORS ARE TYPE 2N3415 OTHERWISE SPECIFIED.
IODES ARE IN4148 UNLESS OTHERWISE IED.
ESISTORS WITH ASTERICK ARE 1% TOL.
PWARD ARROWS GO +11V UNLESS RWISE SPECIFIED. ALL DOWNWARD ARROWS -11V UNLESS OTHERWISE SPECIFIED.

NAV-750

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION						LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

DRAWN JJG 2/5/73
CHECKED MJL 2/17/75
APPROVED GJP 2-18-75

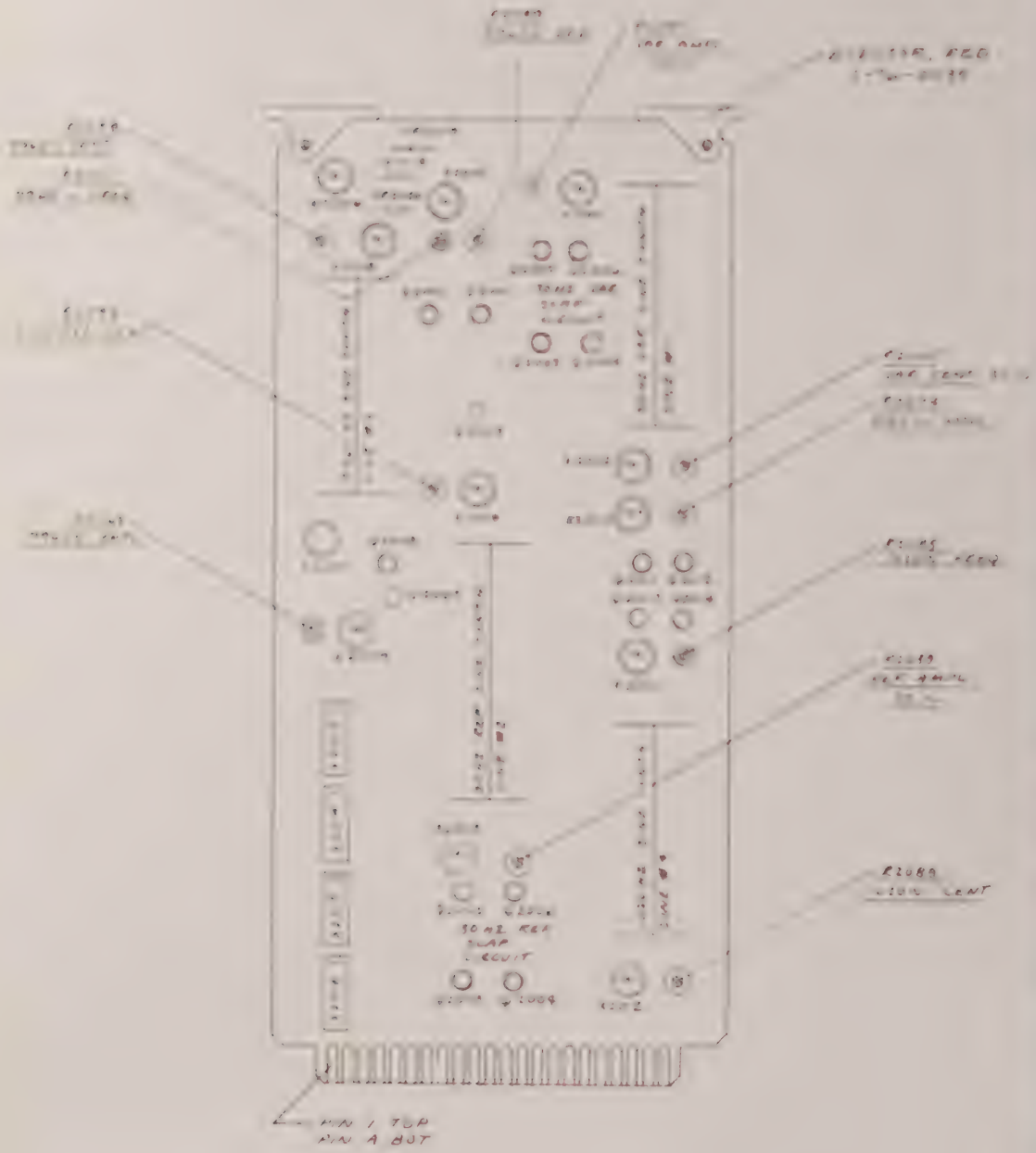
MATERIAL
TREATMENT
FINISH

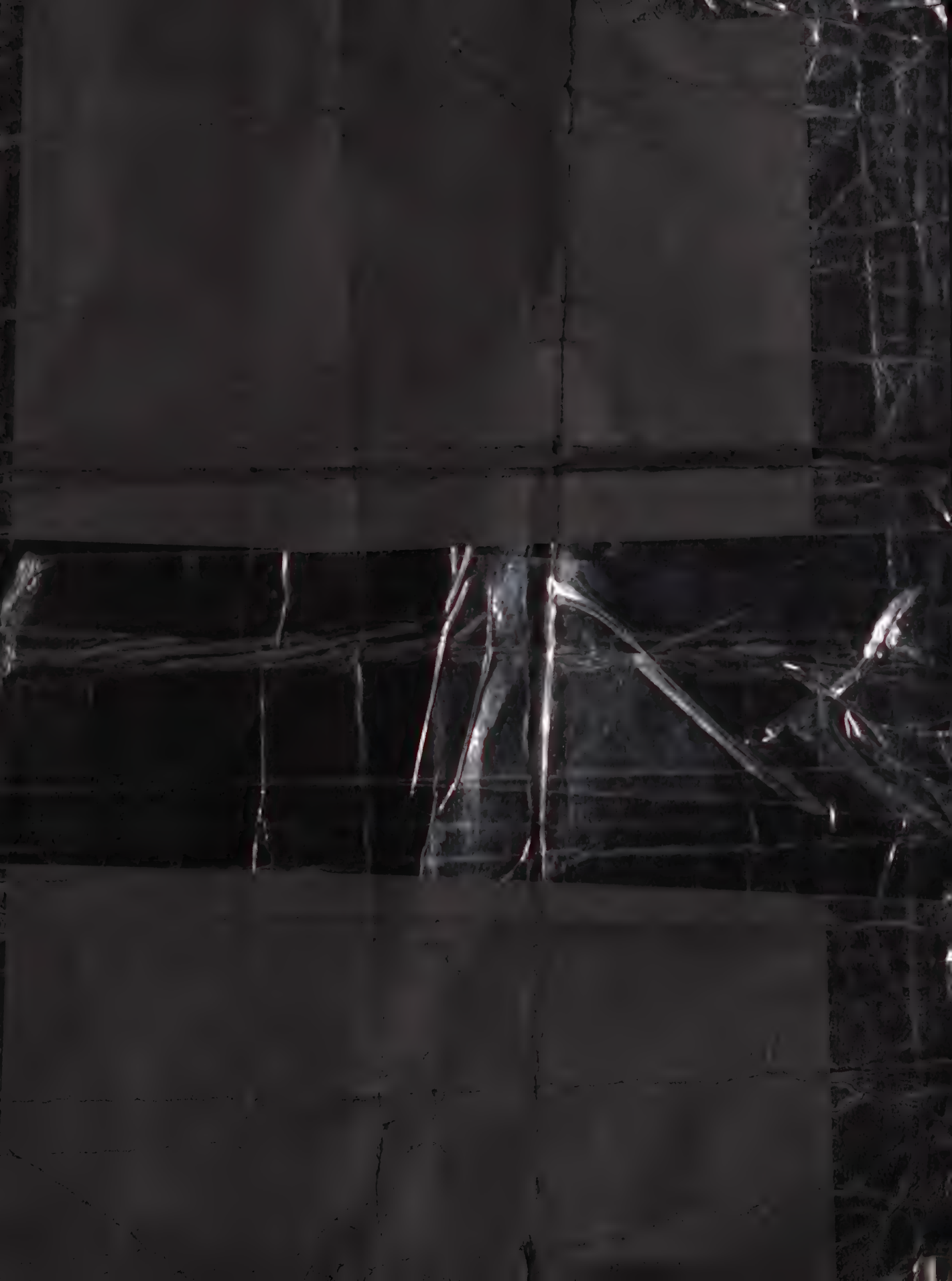
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE
30 HZ SINE BOARD SCHEMATIC
NAV-750 PC-2

SIZE	PART NUMBER	REV
C	3-16-0015	A

SCALE | WEIGHT | SHEET 1 OF 2





DATE	REV	CHANGE	APP'D

1	SYSTEM GND
A	
2	+12V IN
B	
3	+5V IN
C	
4	-12V IN
D	
5	
E	
6	30 Hz REF. INPUT
F	
7	30HZ REF. OUTPUT
H	
8	9960 Hz. OUTPUT
J	
9	30 Hz. VAR. INPUT
K	
10	30HZ VAR. OUTPUT
L	
11	1020 HZ OUTPUT
M	

12	
N	
13	
P	
14	
R	
15	
S	
16	
T	
17	
U	
18	
V	
19	
W	
20	+11V IN
X	
21	-11V IN
Y	
22	SYSTEM GND.
Z	

FIG. 9-16

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	RED EJECTORS DESCRIPTION

APPLICATION — LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 V
REMOVE ALL BURRS

DRAWN JIG 5/14/73
CHECKED RR 7/25/73
APPROVED 98 2-26-75

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

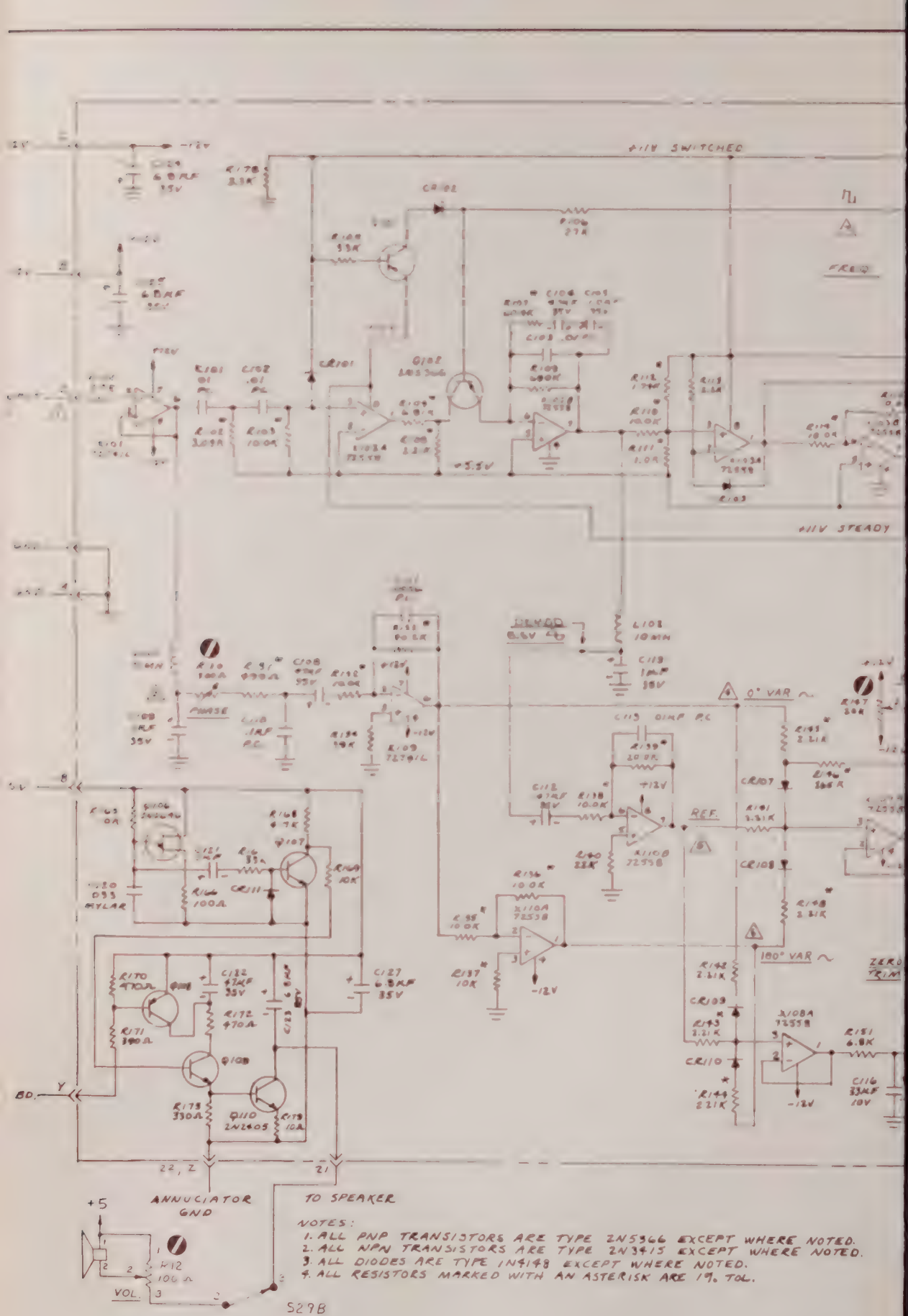
TITLE: 30 HZ SINE BD, MECH. LAYOUT NAV-750 PC-2

SIZE C | PART NUMBER 3-16-0015 | REV

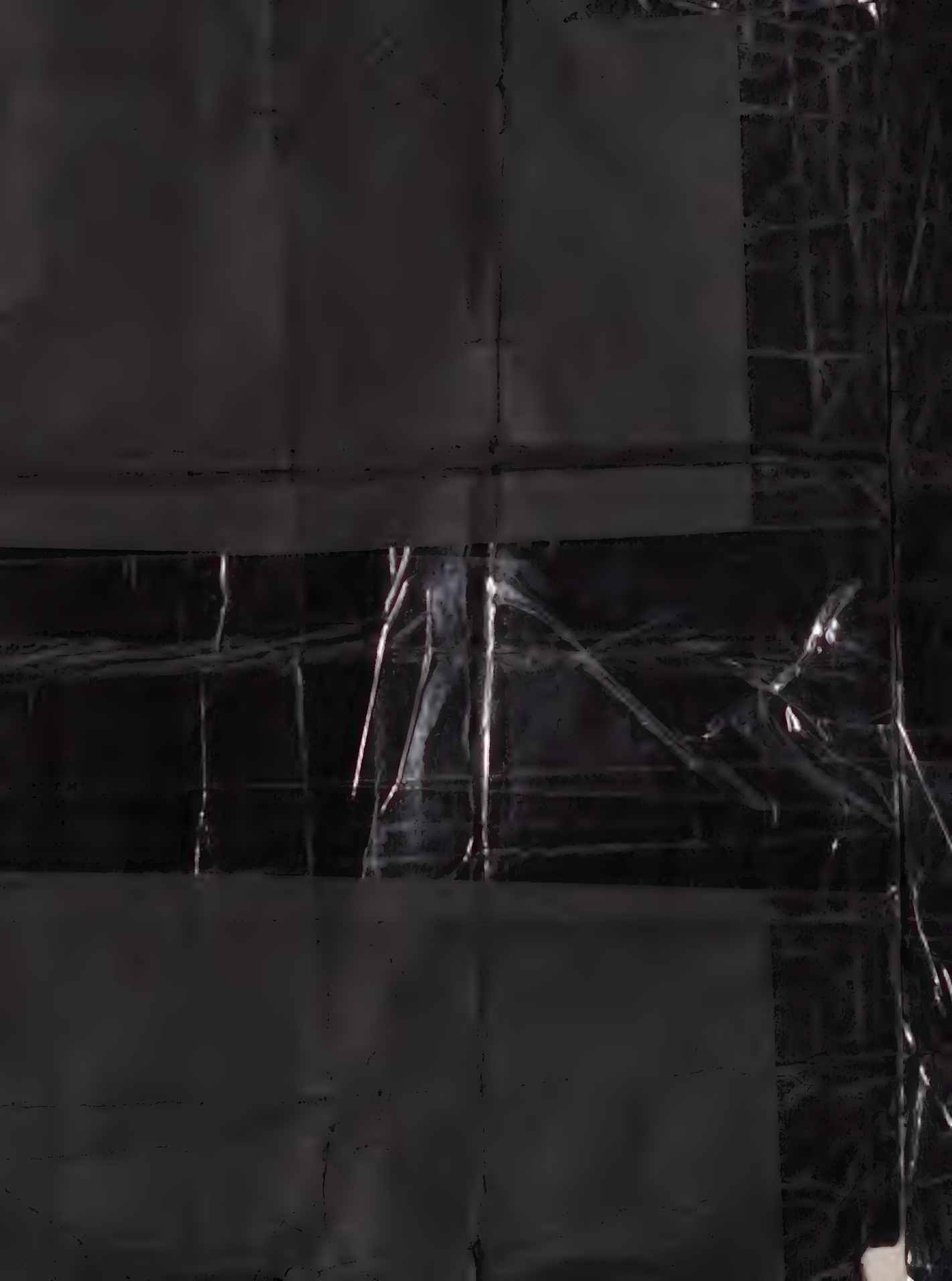
MATERIAL
TREATMENT
FINISH

SCALE | WEIGHT | SHEET 2 OF 2

DET 1.
J3-
SYSTEM
SYSTEM
TO FRE
J6-6



NOTES:
1. ALL PNP TRANSISTORS ARE TYPE 2N5366 EXCEPT WHERE NOTED.
2. ALL NPN TRANSISTORS ARE TYPE 2N3415 EXCEPT WHERE NOTED.
3. ALL DIODES ARE TYPE 1N4148 EXCEPT WHERE NOTED.
4. ALL RESISTORS MARKED WITH AN ASTERISK ARE 1% TOL.



DATE	REV	CHANGE	APP'D
9-4-74	A	INC. ECN #1 LD	

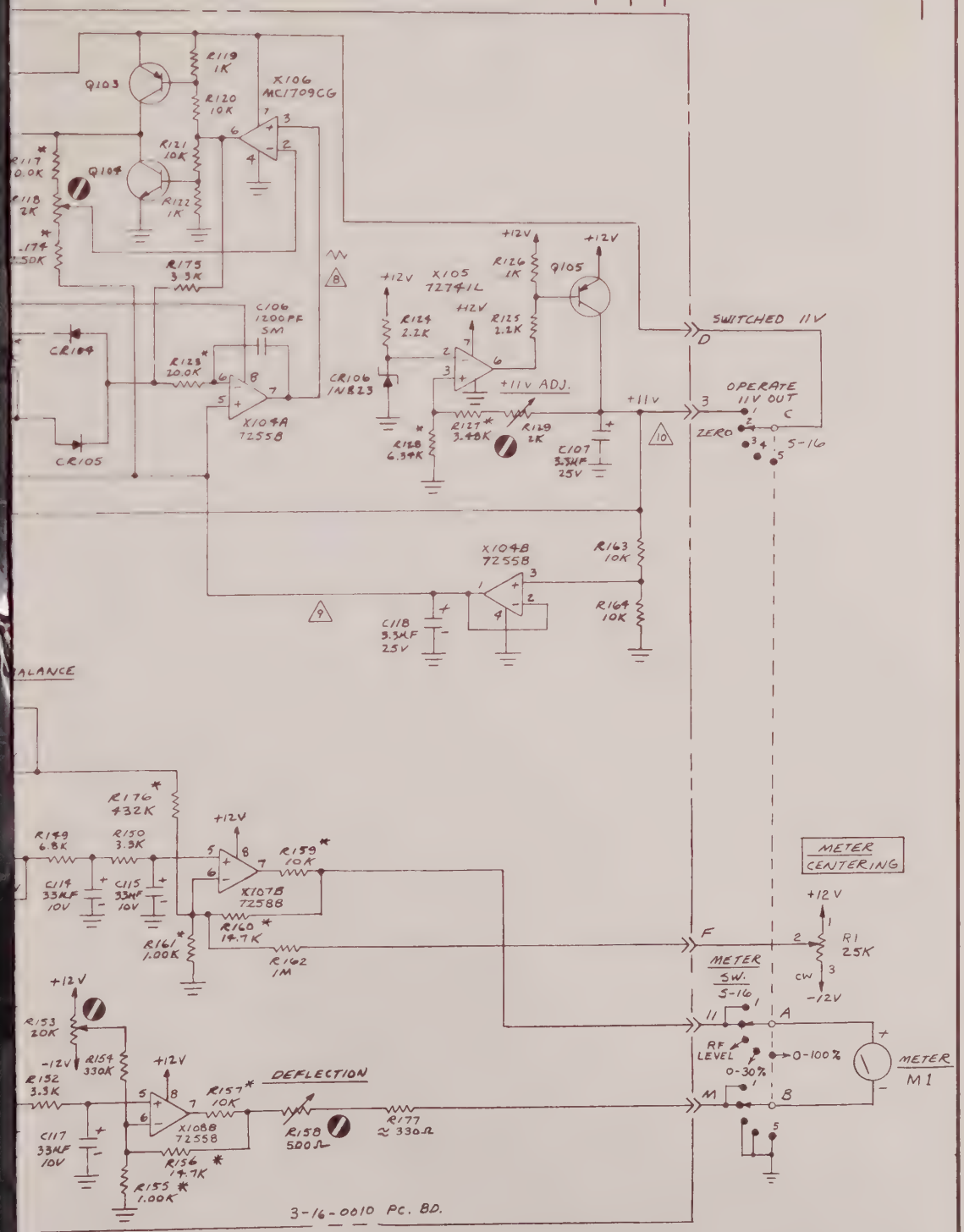


FIG. 9-17

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	BROWN EJECTORS DESCRIPTION
		NAV-750				

APPLICATION — LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS
MATERIAL
TREATMENT
FINISH

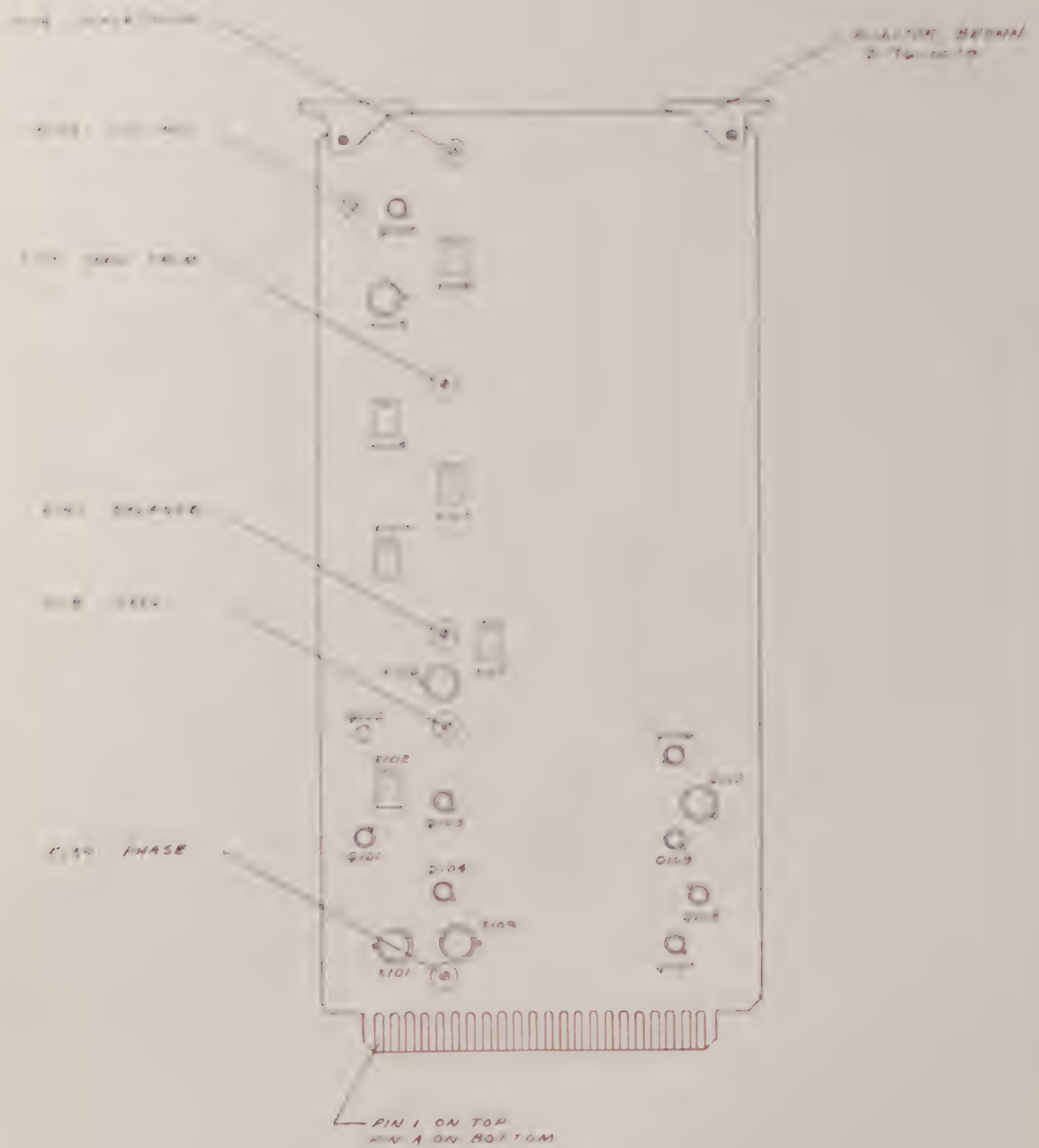
DRAWN JIG 2/2/73
CHECKED RP 7/25/73
APPROVED DATE 1-17-74

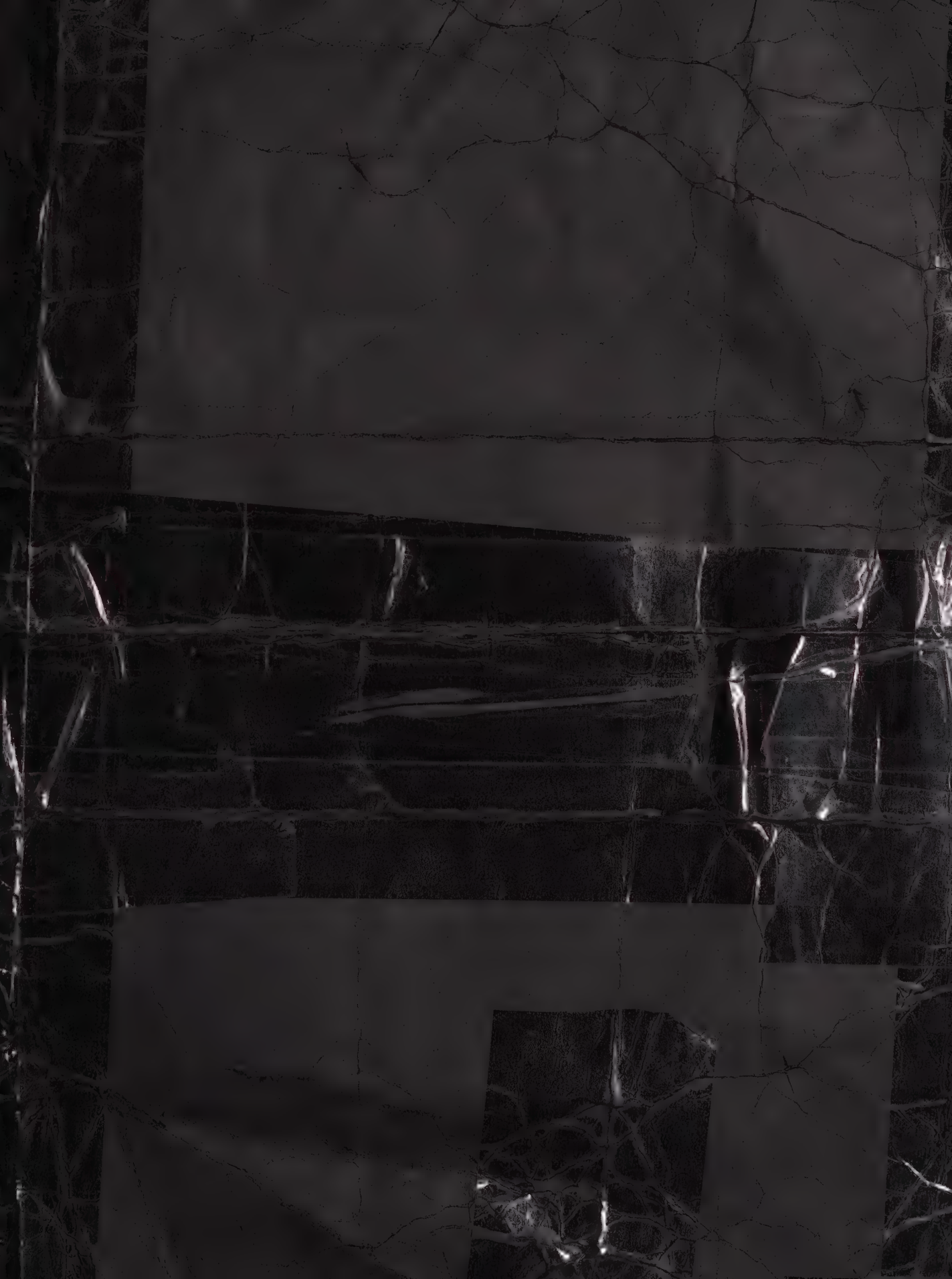
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

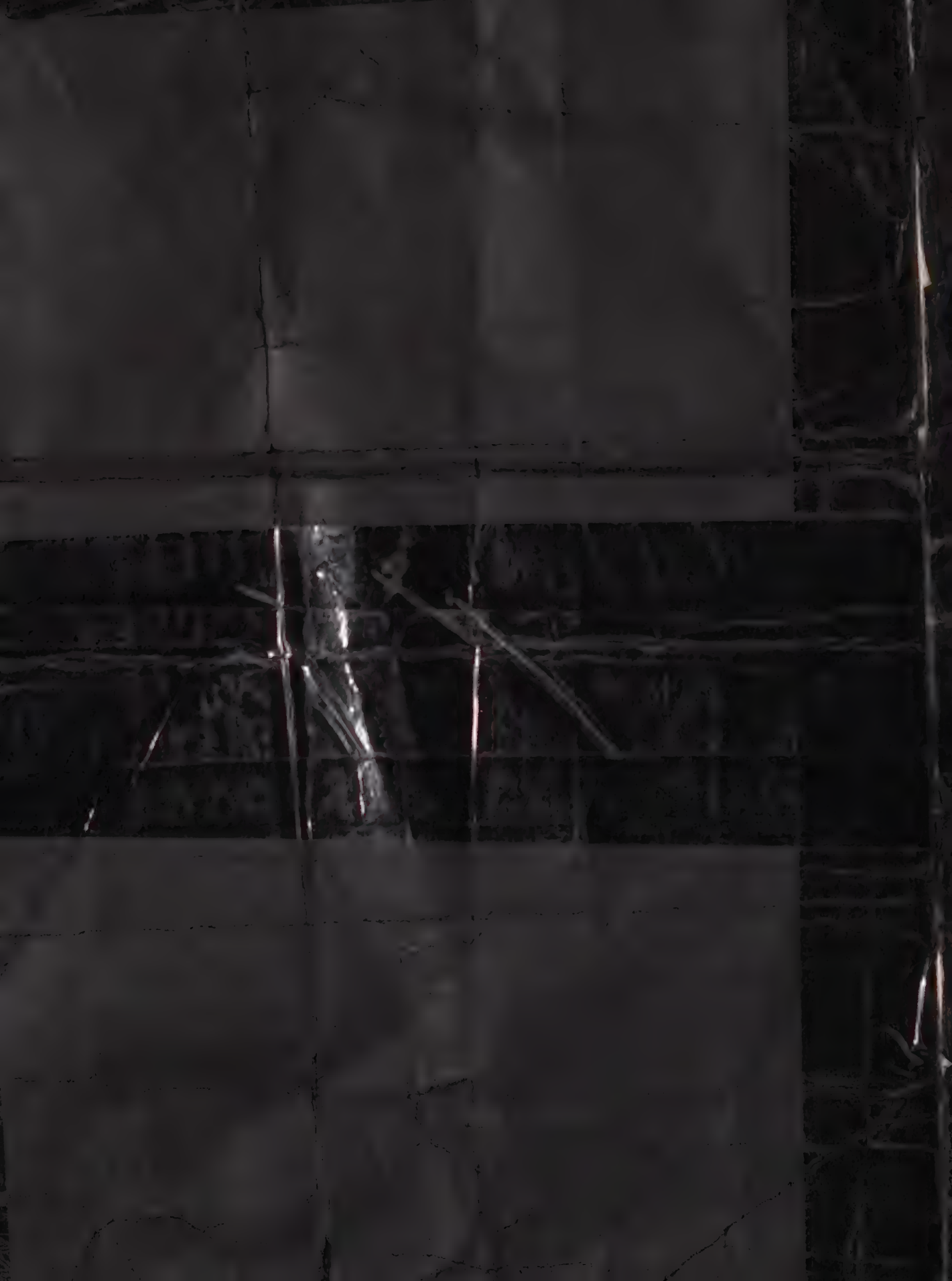
TITLE: BEARING CHECK BD. SCHEMATIC
NAV-750 PC-1

SIZE C | PART NUMBER 3-16-0021 | REV A

SCALE | WEIGHT | SHEET 1 OF 2


PHASE
PIN 1 ON TOP
PIN A ON BOTTOM





DATE	REV	CHANGE	APP'D

	SYSTEM GND BRG
A	SYSTEM GND BRG
2	ORT. INPUT
B	+12V IN
3	+11V OUT
C	+12V IN
4	
D	SWITCHED +11V
5	
E	
6	
F	METER CENTERING POT.
7	
H	
8	
J	
9	
K	
10	
L	
11	+ TO METER SW
M	- TO METER SW.

12	
N	
13	
P	
14	
R	
15	
S	
16	
T	
17	
U	
18	+5V IN
V	
19	
W	
20	
X	
21	TO SPEAKER
Y	TO FREQ. BD
22	ANNUNCIATOR GND
Z	ANNUNCIATOR GND

FIG. 9-18

		NAV-750				BROWN EJECTORS
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION					LIST OF MATERIALS	

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

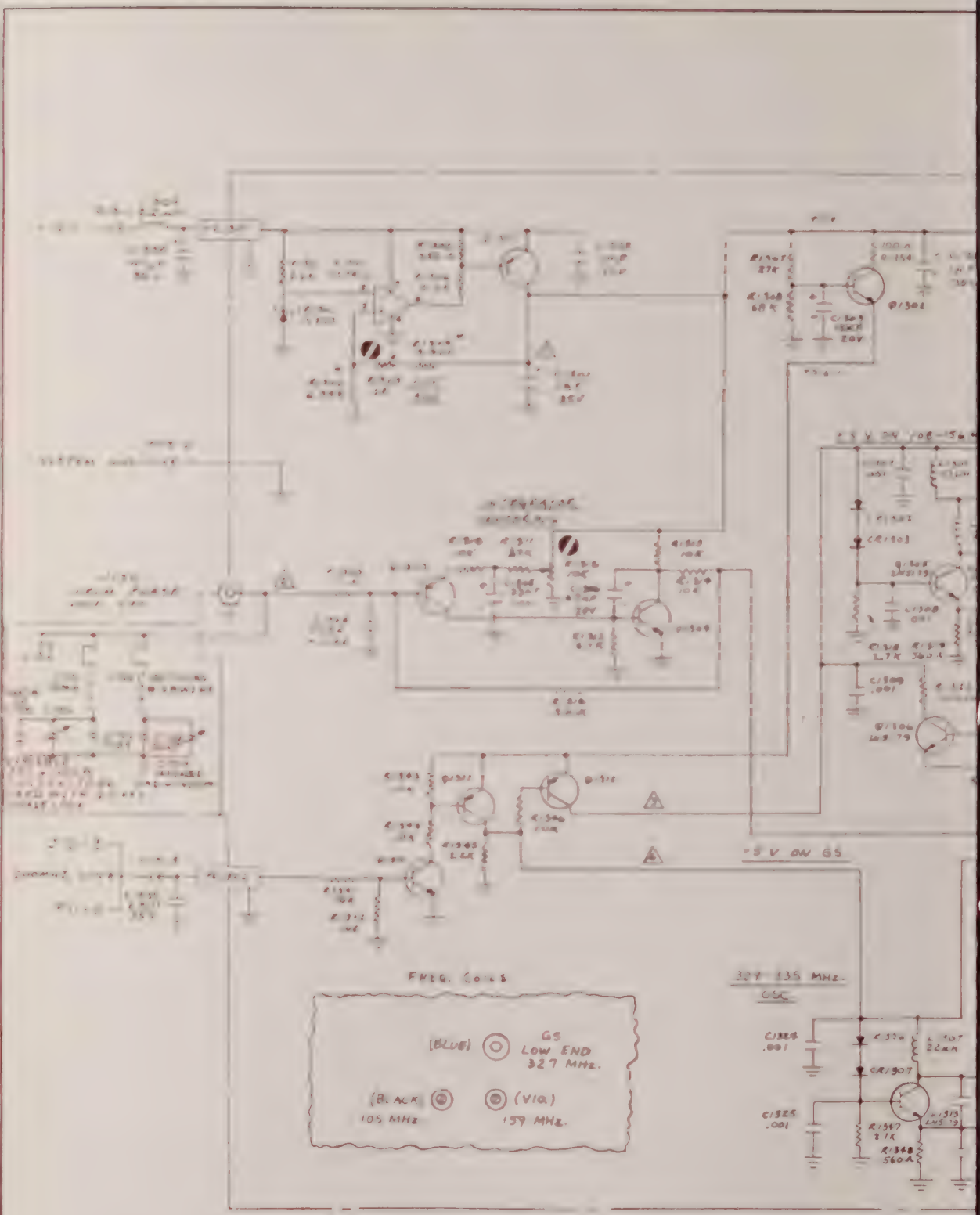
DRAWN JIG 6/13/73
CHECKED RK 7/25/73
APPROVED [illegible] 1-17-74

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE
BEARING CHECK BOARD
MECH. LAYOUT
NAV-750 PC-1

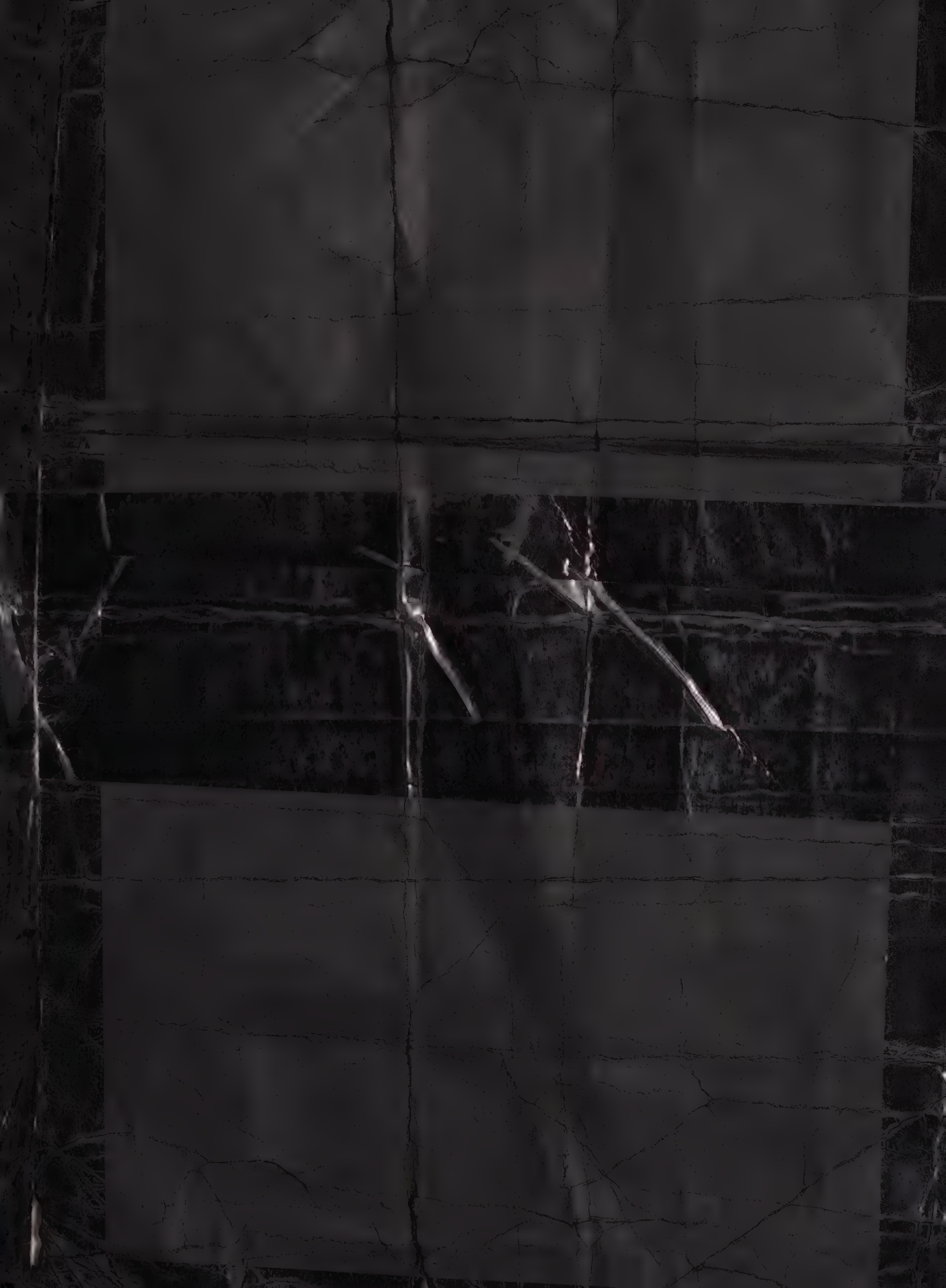
MATERIAL
TREATMENT
FINISH

SIZE C | PART NUMBER 3-16-0021 | REV
SCALE 1:1 | WEIGHT | SHEET 2 OF 2



NOTES:

1. ALL PNP TRANSISTORS ARE 2N5366 UNLESS OTHERWISE SPECIFIED.
2. ALL NPN TRANSISTORS ARE 2N3415 UNLESS OTHERWISE SPECIFIED.
3. ALL DIODES ARE TYPE 1N4148 UNLESS OTHERWISE SPECIFIED.
4. ALL RESISTORS MARKED WITH AN ASTERISK ARE 1% TOL.
5. FOR UNITS WITH 12.5 KHz PHASELOCK CHANGE C1304 TO .001UF AND R1316 – 33K.



DATE	REV	CHANGE	
[illegible]	A	INCORPORATED ECN #1 [illegible]	[illegible]
[illegible]	[illegible]	[illegible] ECN-2 [illegible] (ADDED [illegible])	[illegible]
[illegible]	[illegible]	INCORP. ECN-3 VLS (ADDED CR1309)	[illegible]
11/20/74	D	INCORPORATED ECN #4 SSD	[illegible]
[illegible]	E	INCORPORATED ECN #5 SSD	[illegible]
[illegible]	F	INC. ECN# 236 LD.	[illegible]
[illegible]	G	INCORPORATED ECN # 388 SSD	[illegible]

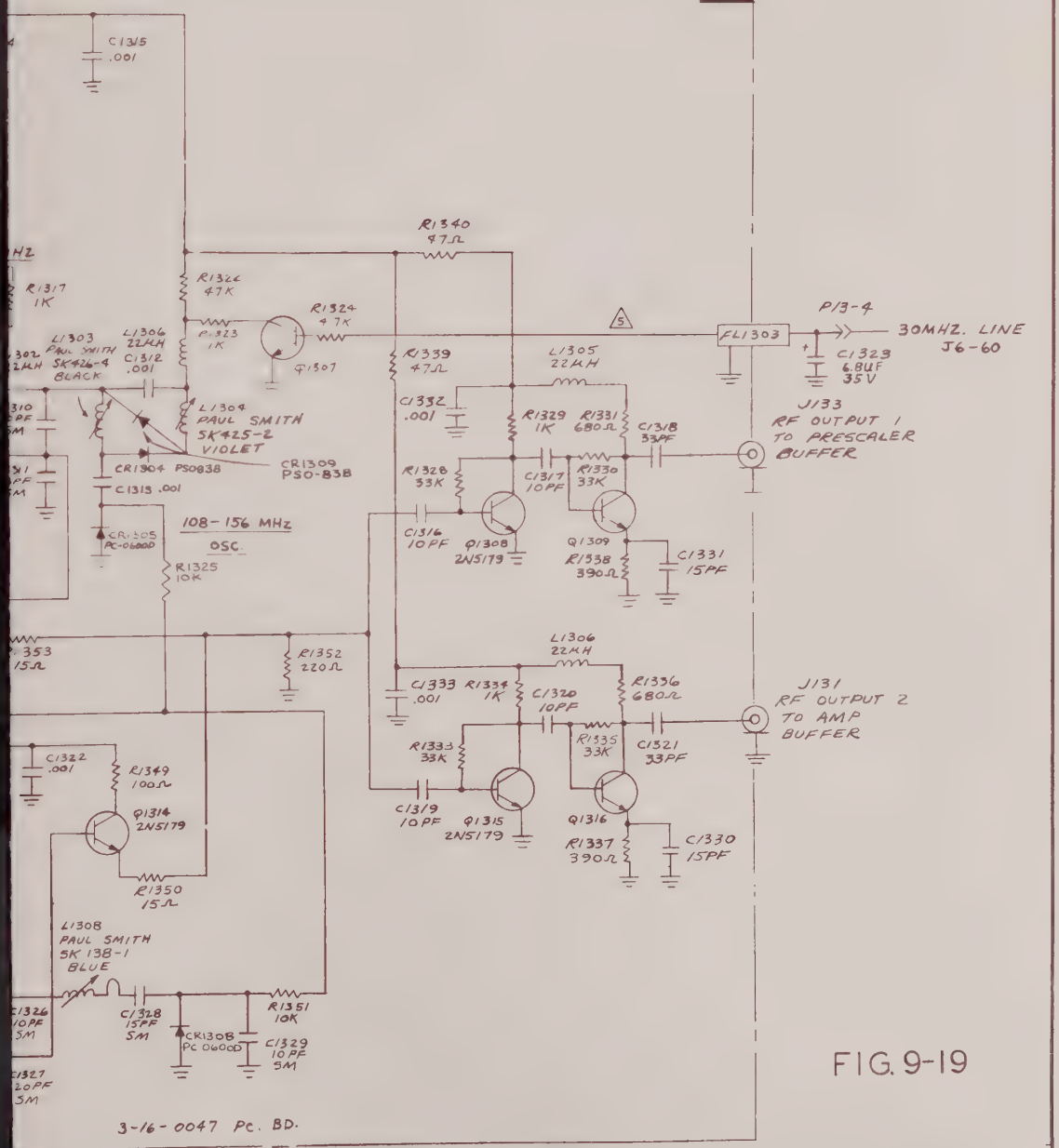


FIG. 9-19

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
		NAV 750				

APPLICATION

LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 126
REMOVE ALL BURRS

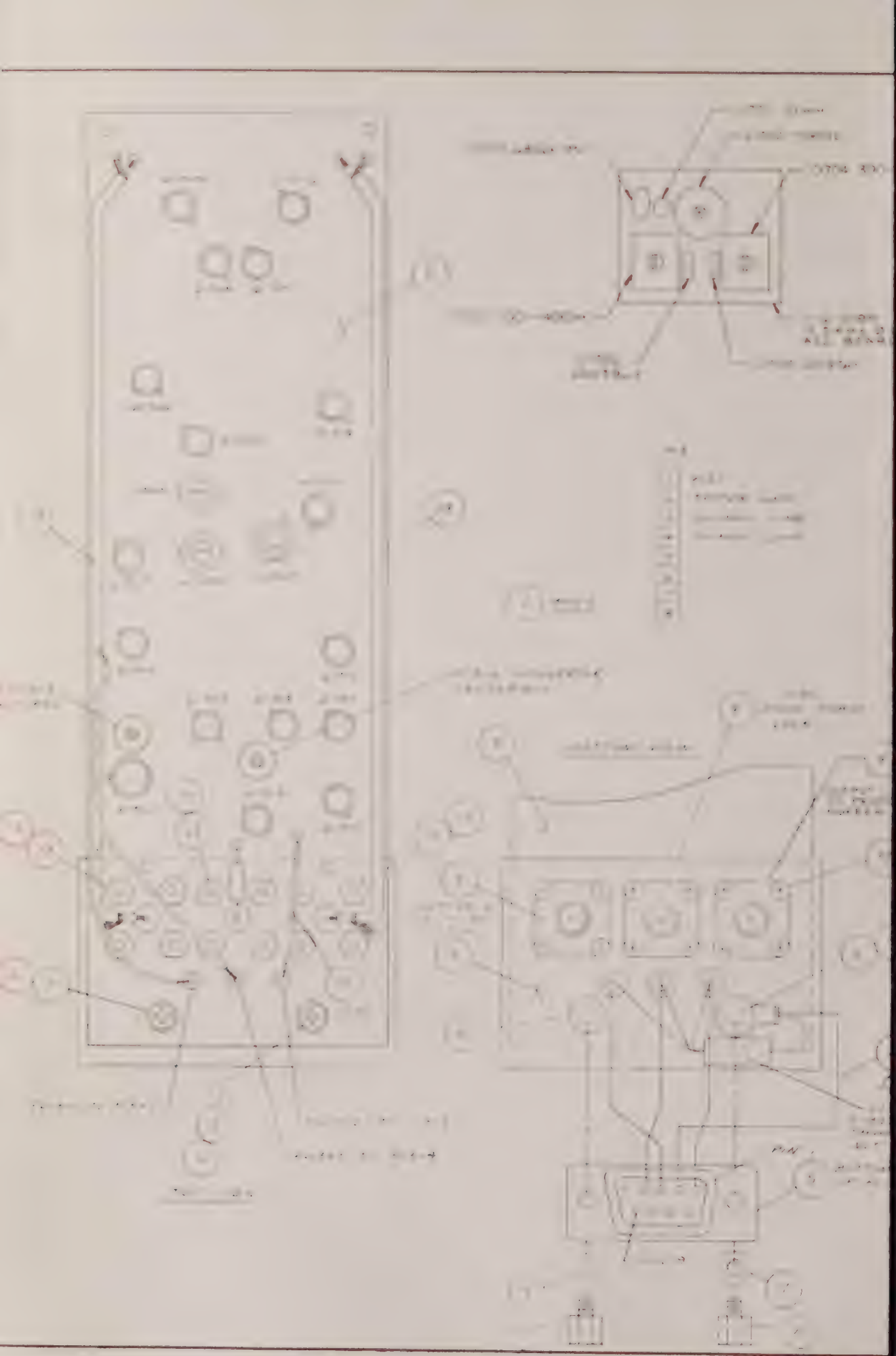
DRAWN DATE 3/10/73
CHECKED DATE
APPROVED DATE

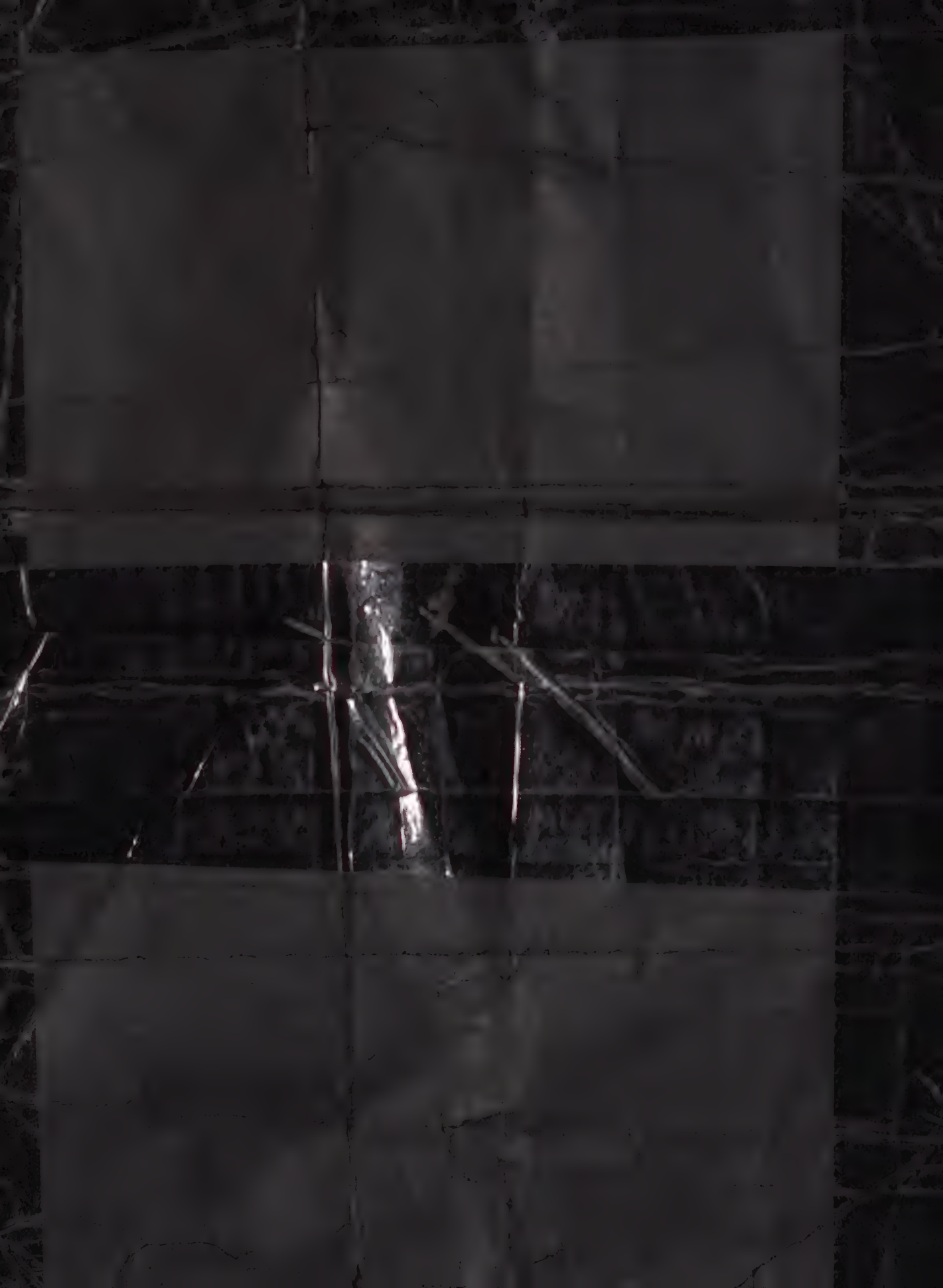
MATERIAL
TREATMENT
FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE
OSCILLATOR SCHEMATIC NAV-750

SIZE C | PART NUMBER 3-16-0022 | REV G
SCALE | WEIGHT | SHEET 1 OF 2





400 pf

OCK

ALER

DATE	REV	CHANGE	APP'D

		MAV 750	1	1	316 0022	OSCIL. A-CK MECH ASS'Y
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION			LIST OF MATERIALS			

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

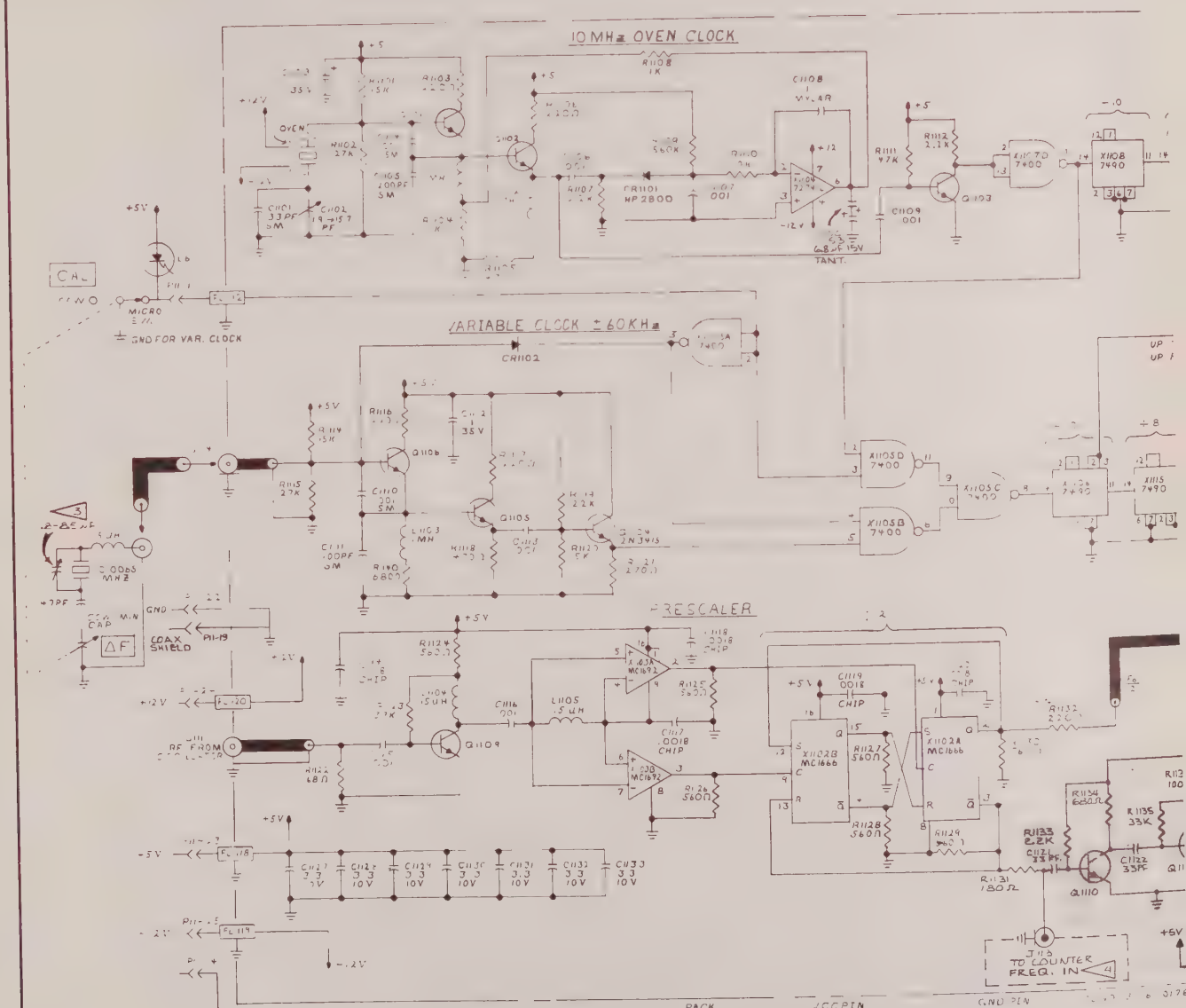
DRAWN DATE 6/25/73
CHECKED DATE
APPROVED DATE

TITLE
DETAIL

MATERIAL
TREATMENT
FINISH

SIZE C | PART NUMBER 3-16-022 | REV F
SCALE 2:1 | WEIGHT | SHEET 2 OF 2

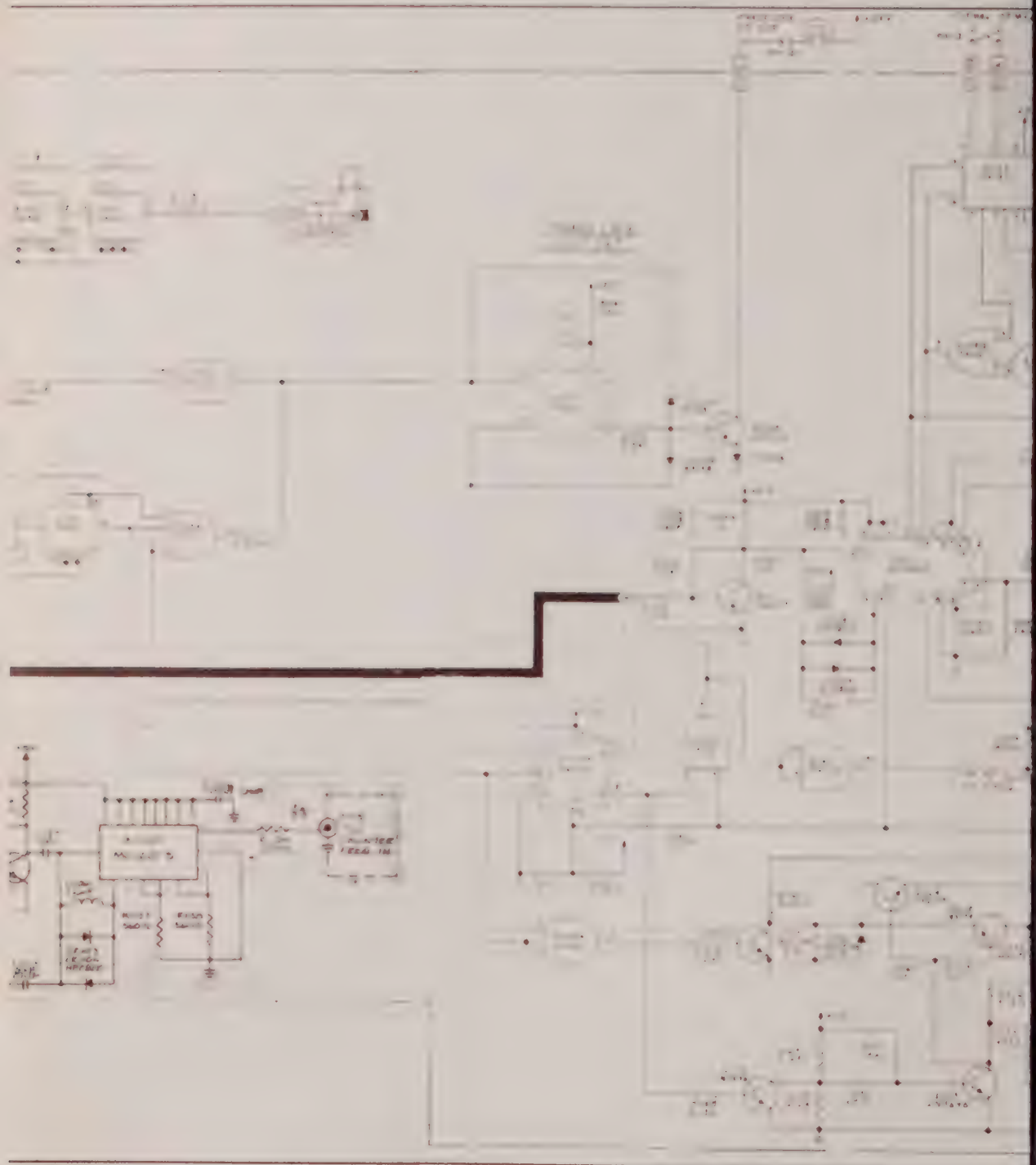
FIG.9-20

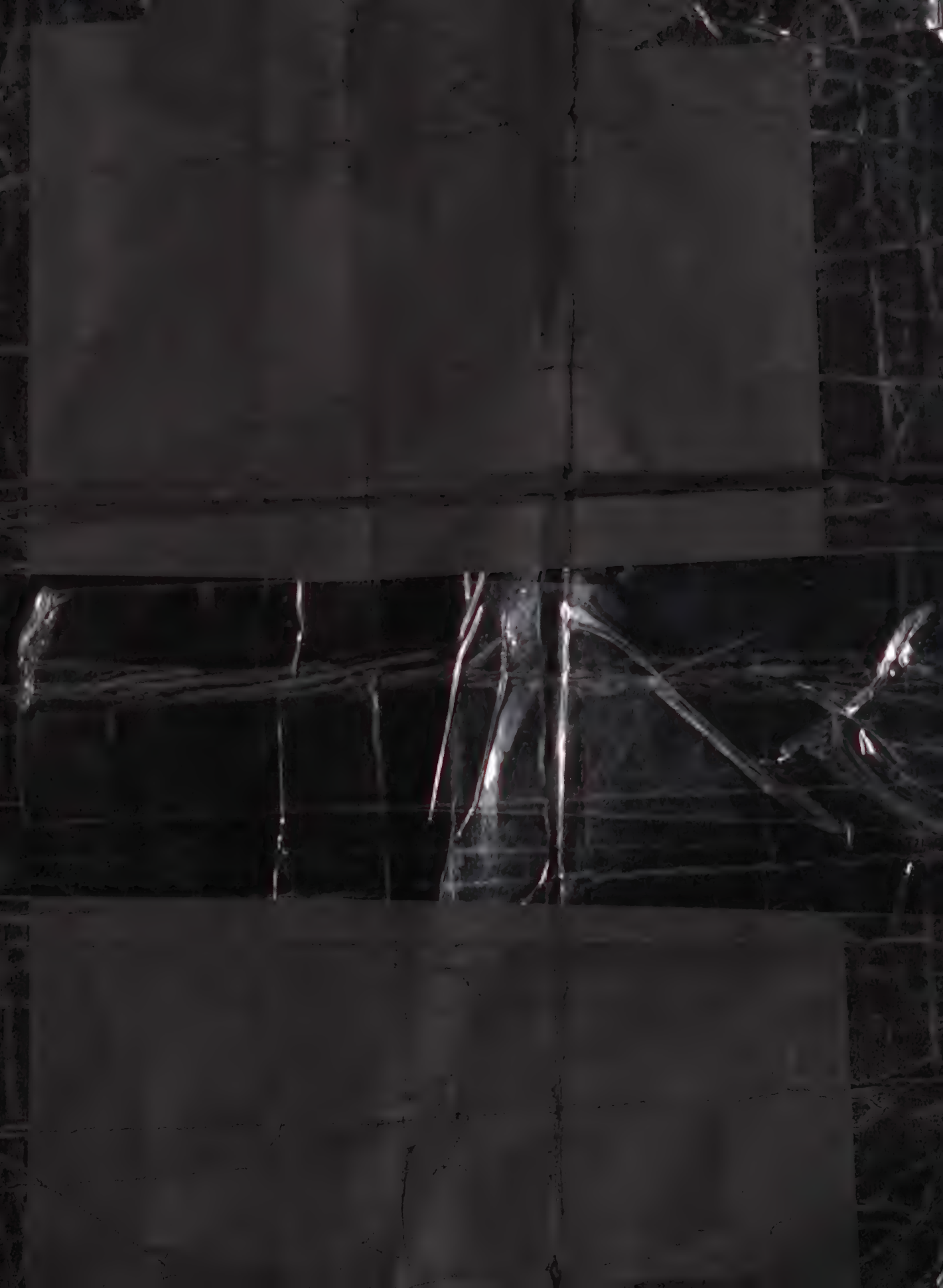


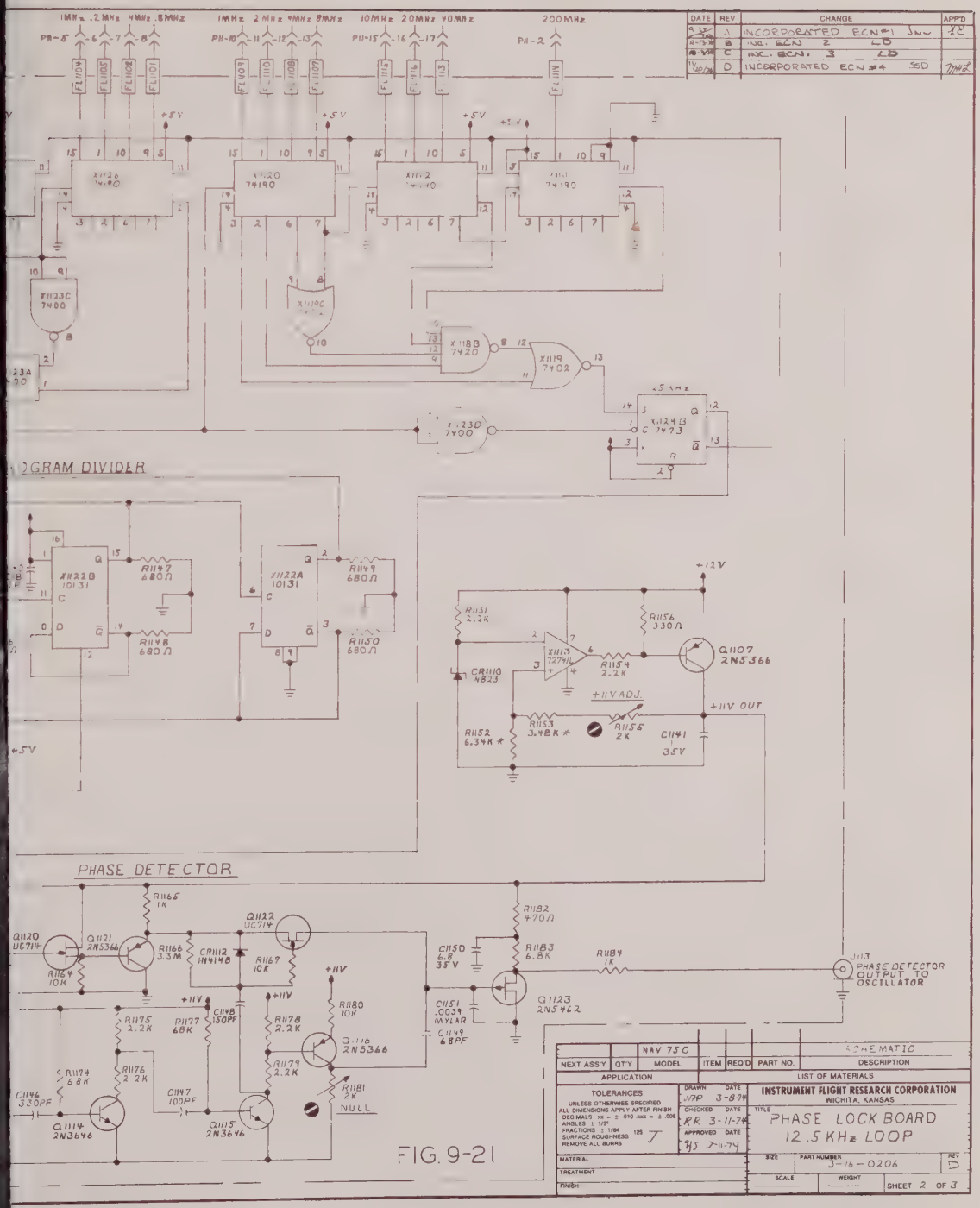
NOTES:

1. ALL TRANSISTORS ARE TYPE 2N5179 EXCEPT AS NOTED.
2. ALL CAPACITORS ARE IN MICRO FARADS EXCEPT AS NOTED.
3. THIS CAP IS USED AS NEEDED & MAY NOT BE ON ALL SETS
4. J113 IS USED IN THIS CONFIG. S/N 170-180 & 184 & UP
5. ALL CKT DATA IN SHADED AREA USED PRIOR TO SN 170 & IN SN 171 & 181-183. IN SN170 & 184 & UP CIRCUITRY WILL BE FOUND INSIDE BACK PANEL OF DIGITAL COUNTER ENCLOSURE REF SCHEMATIC 1-16-0221

PACK	VCC PIN	GND PIN
7400	14	7
7402	14	7
7420	14	7
7490	5	10
74190	16	8
74191	16	8
MC1666	4-16	7 & 8
MC12013	16	8
MC10131	4-16	8







DATE	REV	CHANGE	APPD
9-12-74	A	INCORPORATED ECN #1 JNW	
9-25-74	B	INC. ECN 2 LD	
9-26-74	C	INC. ECN. 3 LD	
10/24	D	INCORPORATED ECN #4 SSD	

NEXT ASS'Y	QTY	MODEL	ITEM	REQ'D	PART NO.	SCHEMATIC DESCRIPTION
		NAV 750				
APPLICATION						LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS .XX ± .010 .XXX ± .005
ANGLES ± 1/2°
FRACTIONS ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

MATERIAL
TREATMENT
FINISH

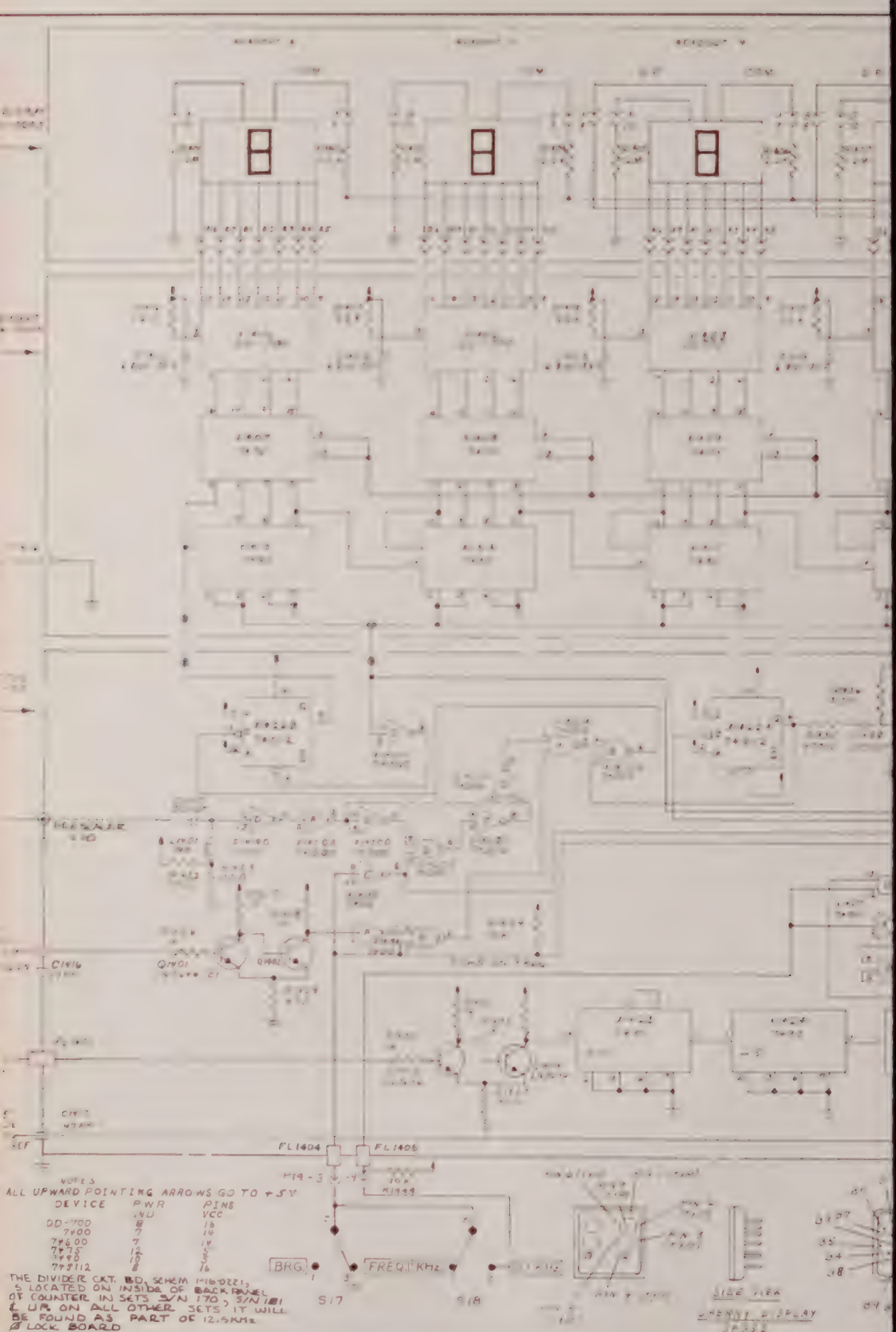
DRAWN WAP 3-8-74
CHECKED KR 3-11-74
APPROVED WJS 3-11-74

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: PHASE LOCK BOARD 12.5 KHz LOOP

SIZE | PART NUMBER 3-16-0206 | REV D
SCALE | WEIGHT | SHEET 2 OF 3

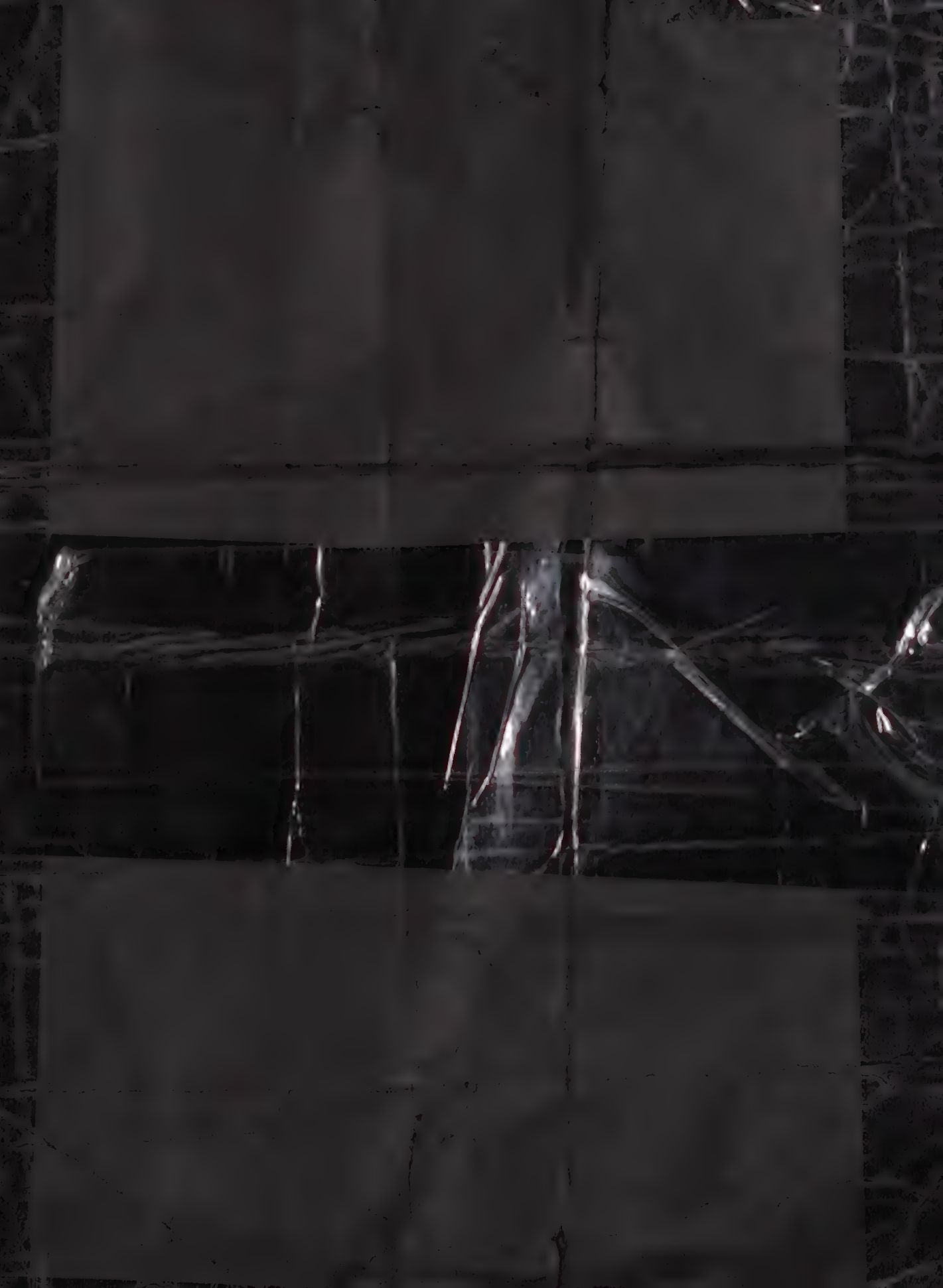
DIGITAL
BOARD 3-
DIGITAL
BOARD 3-
SHIELD GND
DIGITAL GA
BOARD 3-16
J141
FREQ. IN
P14-2
P14-7
12.5 KH
CLOCK IN
P14-1
30H



NOTES
ALL UPWARD POINTING ARROWS GO TO +5V

DEVICE	PWR IND	PINS VCC
DD-700	8	16
7400	7	14
74600	7	14
7475	12	5
7490	10	5
74S112	8	16

THE DIVIDER CKT. BD. SCHEM 1-16-0221, IS LOCATED ON INSIDE OF BACK PANEL OF COUNTER IN SETS S/N 170, S/N 181 & UP. ON ALL OTHER SETS IT WILL BE FOUND AS PART OF 12.5KHz Ø LOCK BOARD



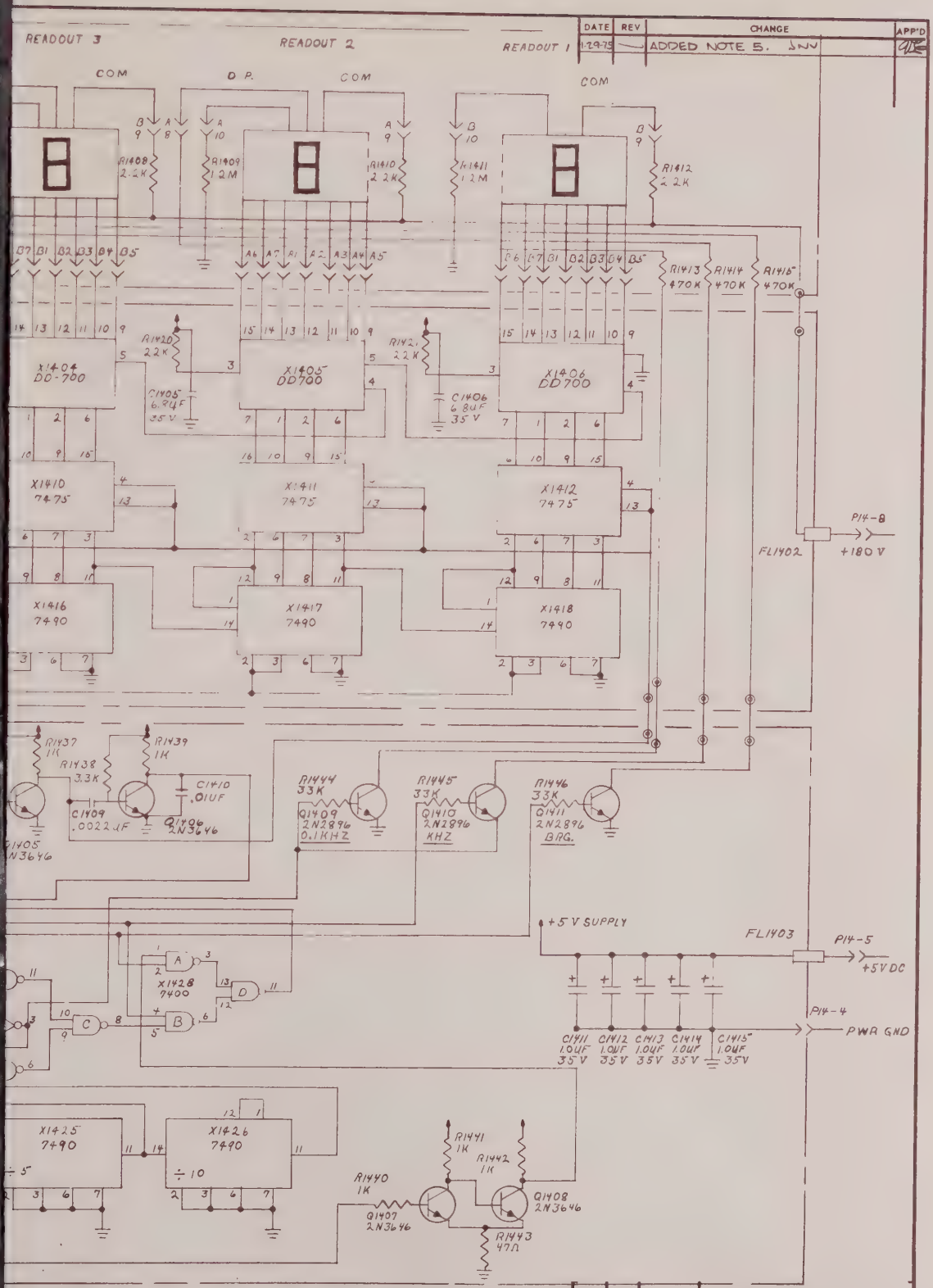
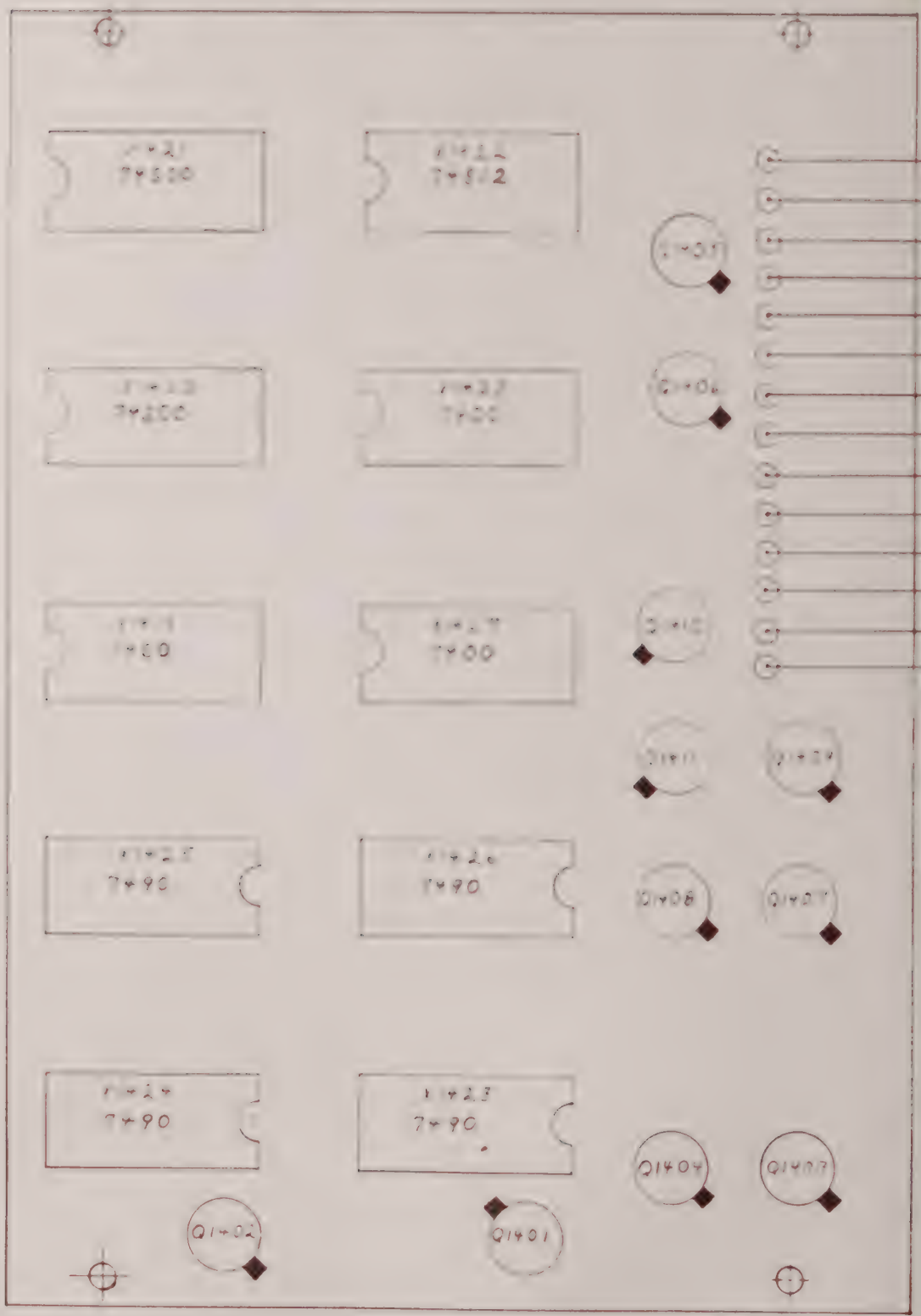
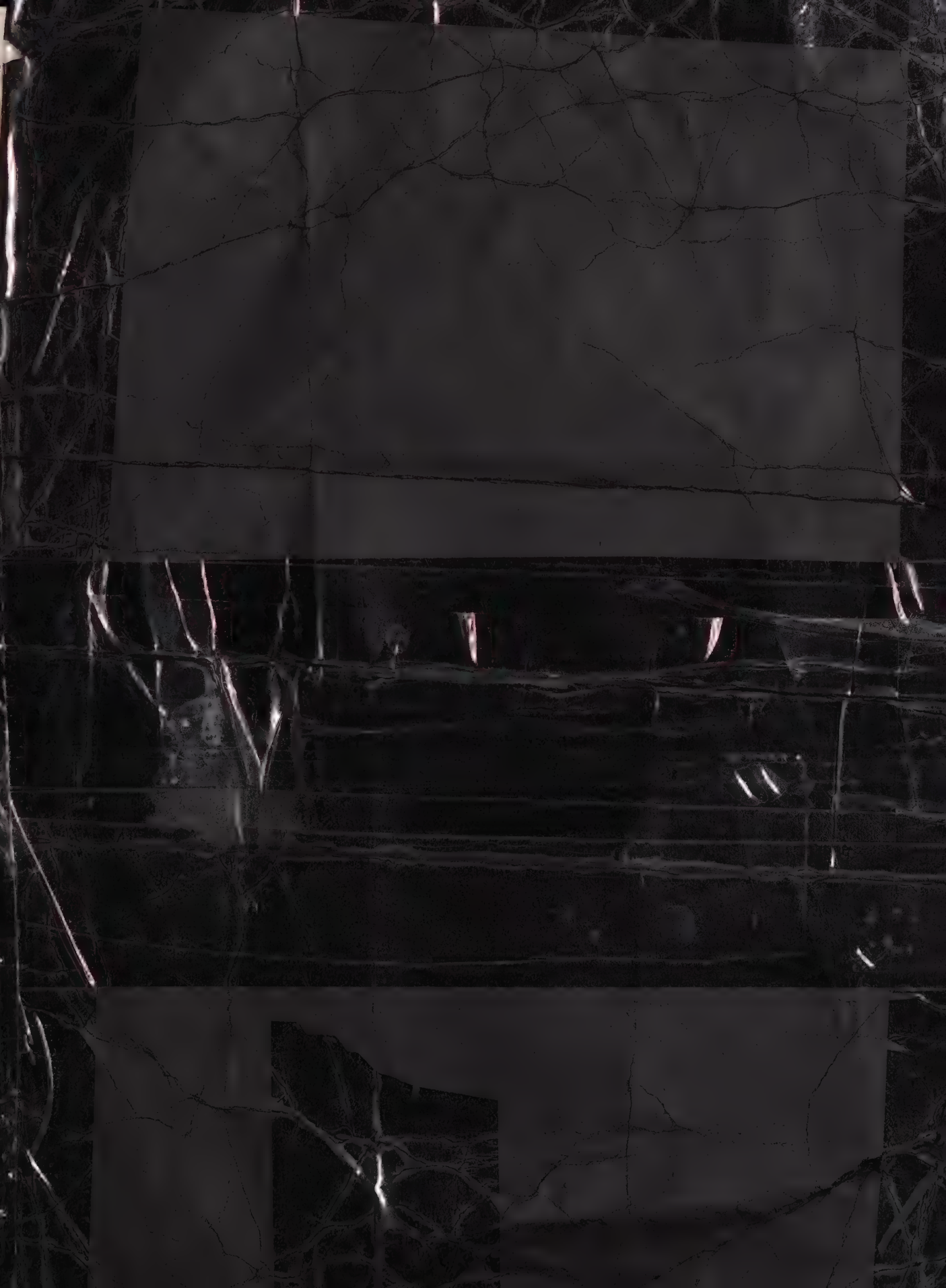
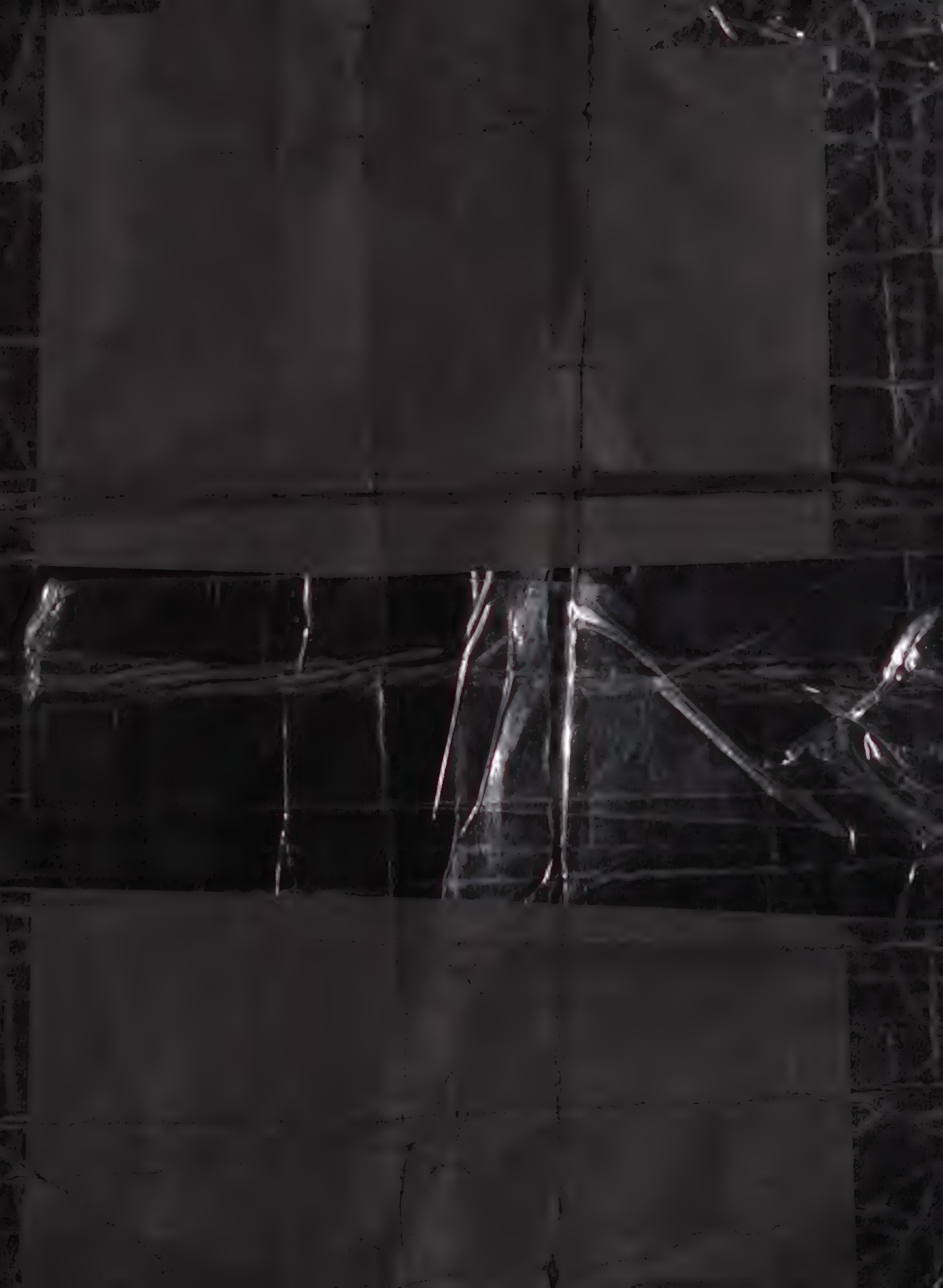

READOUT 3
READOUT 2
READOUT 1
DATE | REV | CHANGE | APP'D
1-29-75 | | ADDED NOTE 5. JNV
COM
D.P.
COM
COM
R1408 2.2K
R1409 1.2M
R1410 2.2K
R1411 1.2M
R1412 2.2K
R1413 470K
R1414 470K
R1415 470K
X1404 DD-700
X1405 DD700
X1406 DD700
R1420 22K
R1421 22K
C1405 6.8UF 35V
C1406 6.8UF 35V
X1410 7475
X1411 7475
X1412 7475
X1416 7490
X1417 7490
X1418 7490
P14-8
FL1402
+18.0 V
R1437 11K
R1438 3.3K
R1439 1K
C1409 .0022UF
C1410 .01UF
Q1405 2N3646
Q1406 2N3646
R1444 33K
R1445 33K
R1446 33K
Q1409 2N2896 0.1KHZ
Q1410 2N2896 KHZ
Q1411 2N2896 BRG.
+5 V SUPPLY
FL1403
P14-5
+5VDC
P14-4
PWR GND
C1411 1.0UF 35V
C1412 1.0UF 35V
C1413 1.0UF 35V
C1414 1.0UF 35V
C1415 1.0UF 35V
X1428 7400
X1425 7490
X1426 7490
÷ 5
÷ 10
R1440 1K
R1441 1K
R1442 1K
R1443 47Ω
Q1407 2N3646
Q1408 2N3646
B2 A1 A6 A2 A7 A3 A8 A5 A4 A10 A9
AS VIEWED FROM FRONT (CHARACTERS REMOVED)
NAV 750 | SCHEMATIC
NEXT ASS'Y | QT'Y | MODEL | ITEM | REQ'D | PART NO. | DESCRIPTION
APPLICATION | LIST OF MATERIALS
TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 √
REMOVE ALL BURRS
MATERIAL
TREATMENT
FINISH
DRAWN DATE WP 8/24/73
CHECKED DATE RR 8/30/73
APPROVED DATE 10/19/73
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS
TITLE
DIGITAL READOUT SCHEMATIC NAV-750
SIZE | PART NUMBER 3-16-0178 | REV
SCALE | WEIGHT | SHEET 1 OF 4

FIG. 9-22







DATE	REV	CHANGE	APP'D

	STROBE
	RESET
	12.5 KHZ INPUT
	+5V
	GND
	OUTPUT TO COUNTER
	BEARING INPUT
	DOWN ON FREQ.
	FREQ. INPUT
	30 HZ. REF.
	GND ON .1KHZ
	0.1KHZ D.P.
	KHZ D.P.
	BRG. D.P.

FIG. 9-23

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
		NAV 750				P.C. BOARD

APPLICATION

LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN W.P. DATE 8/27/73
CHECKED JRF DATE 9-19-73
APPROVED DATE 9.19.73

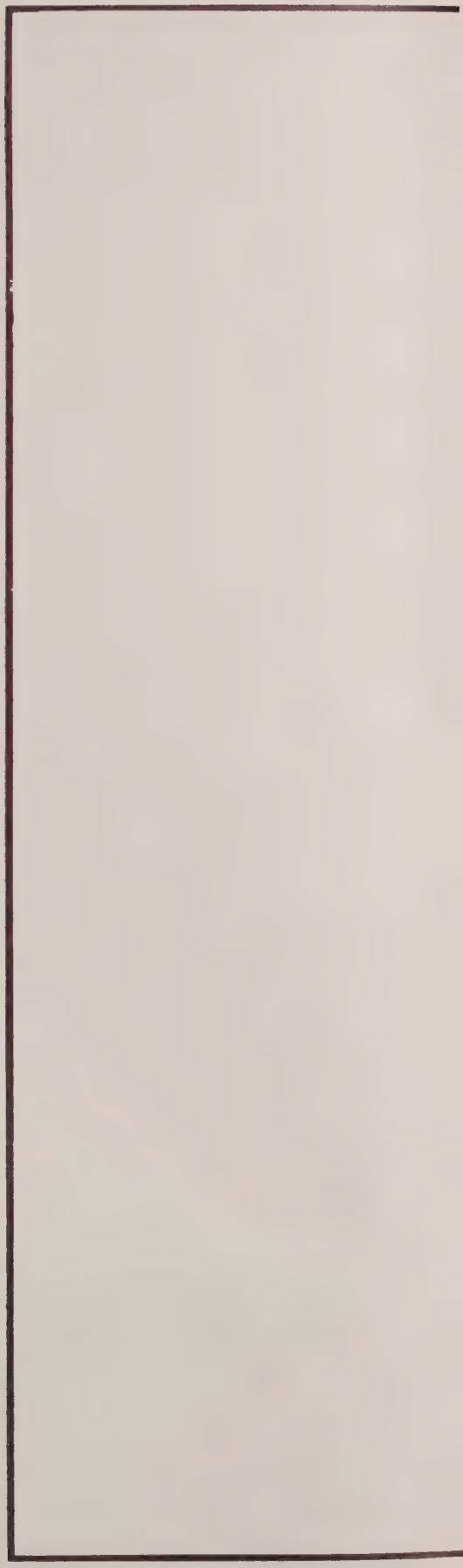
MATERIAL
TREATMENT
FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE
DIGITAL GATING BOARD
NAV 750

SIZE | PART NUMBER 3-16-0178 | REV

SCALE | WEIGHT | SHEET 2 OF 4



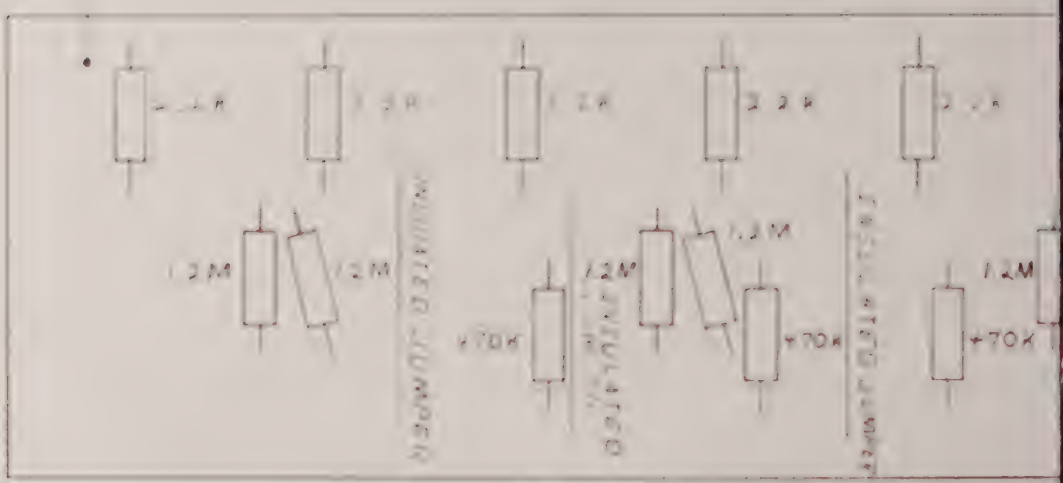
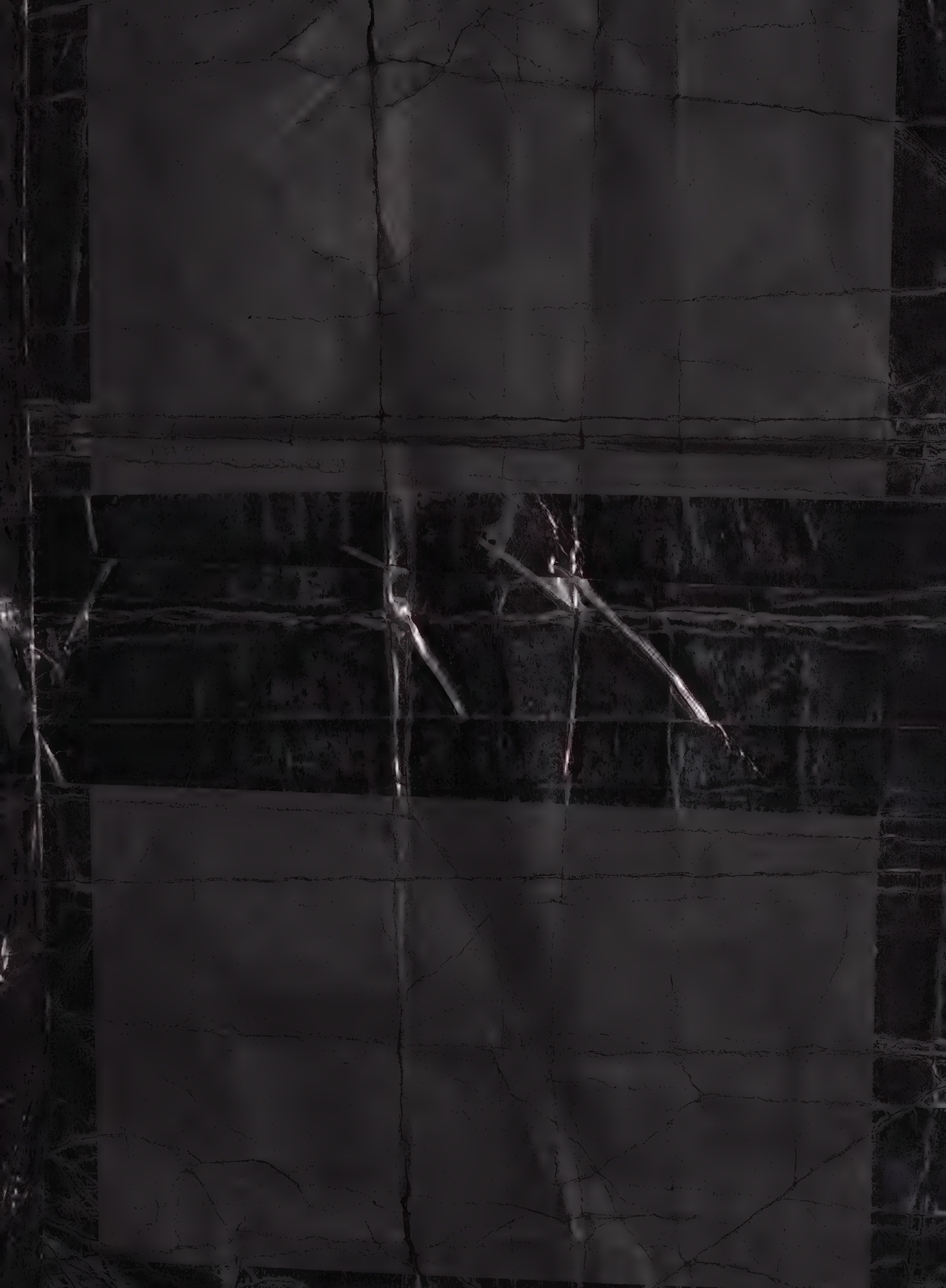
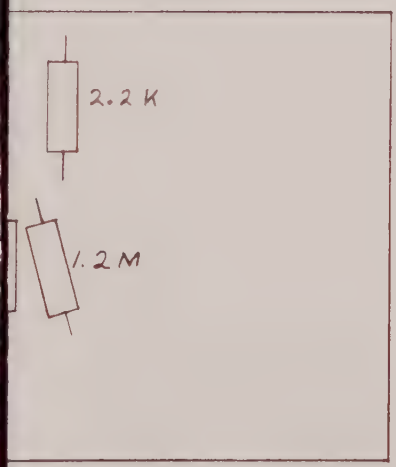


FIG. 9-24



DATE	REV	CHANGE	APP'D



NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
		NAV 750				P.C BOARD

APPLICATION

LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

DRAWN DATE: WP 8-28-73
CHECKED DATE: JRF 9-17-73
APPROVED DATE: 9-24-73

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: DIGITAL DISPLAY BOARD
NAV 750

MATERIAL
TREATMENT
FINISH

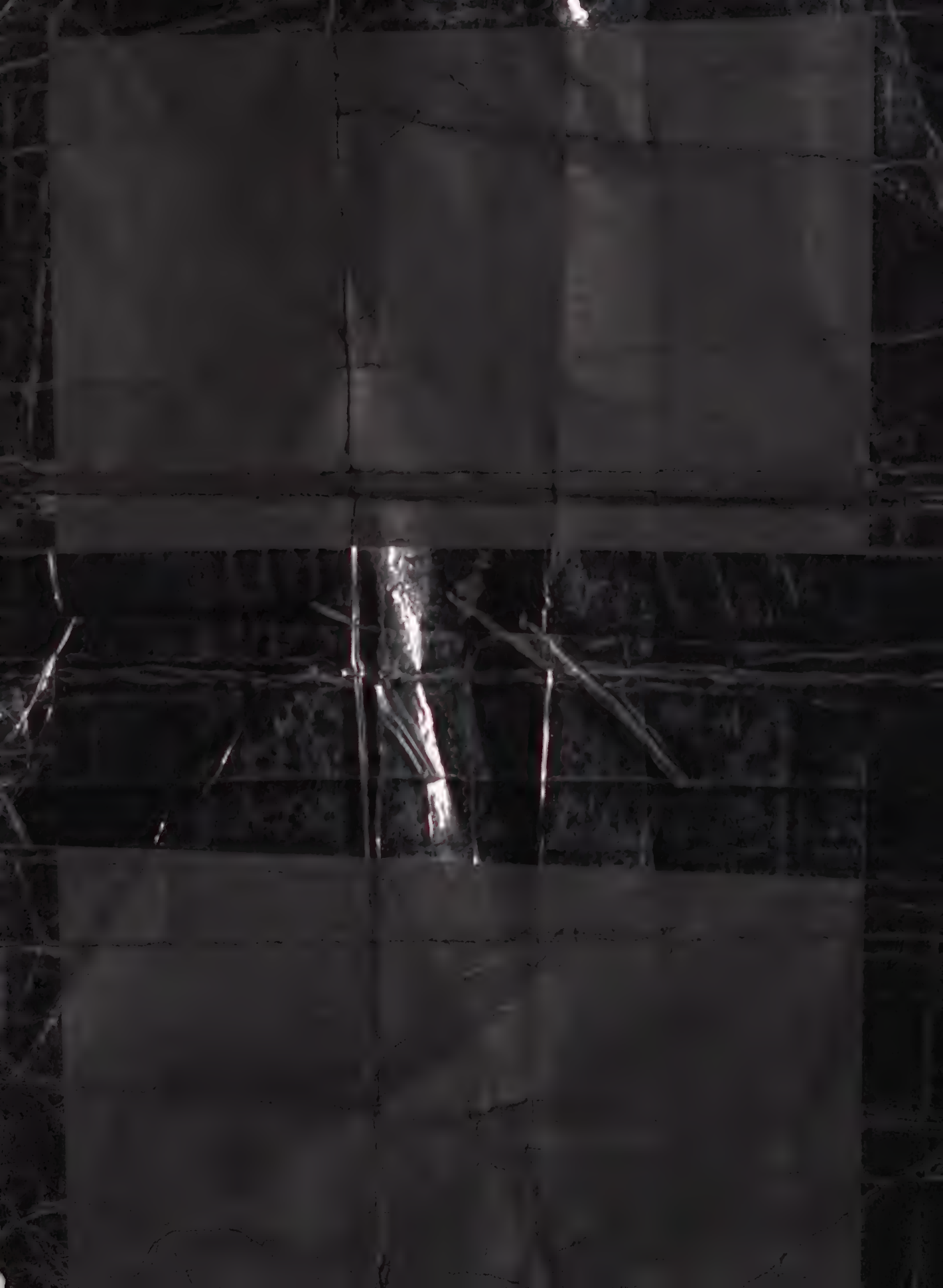
SIZE | PART NUMBER: 3-16-C178 | REV

SCALE | WEIGHT

SHEET 3 OF 4

X1406
DD70
WI
X140
DD70
WI
X
DL
X
D
X
DL
X
D

E JUMPER
X1412
7475
X1418
7490
E JUMPER
X1412
7475
X1417
7490
X1410
7475
X1416
7490
X1409
7475
X1415
7490
X1408
7475
X1414
7490
X1407
7475
X1413
7490



DATE	REV	CHANGE	APP'D

STROBE

RESET

12.5 KHZ INPUT

+5 V

GND

INPUT TO COUNTER

BEARING IN

DOWN ON FREQ.

FREQ. INPUT

30 HZ REF.

GND. ON .1KHZ

0.1KHZ D.P.

KHZ D.P.

BRG. D.P.

+200 V

FIG. 9-25

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
		NAV 750				PC. BOARD LAYOUT

APPLICATION

LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

DRAWN WP DATE 9-4-73
CHECKED JRG DATE 9-19-73
APPROVED DATE 9-19-73

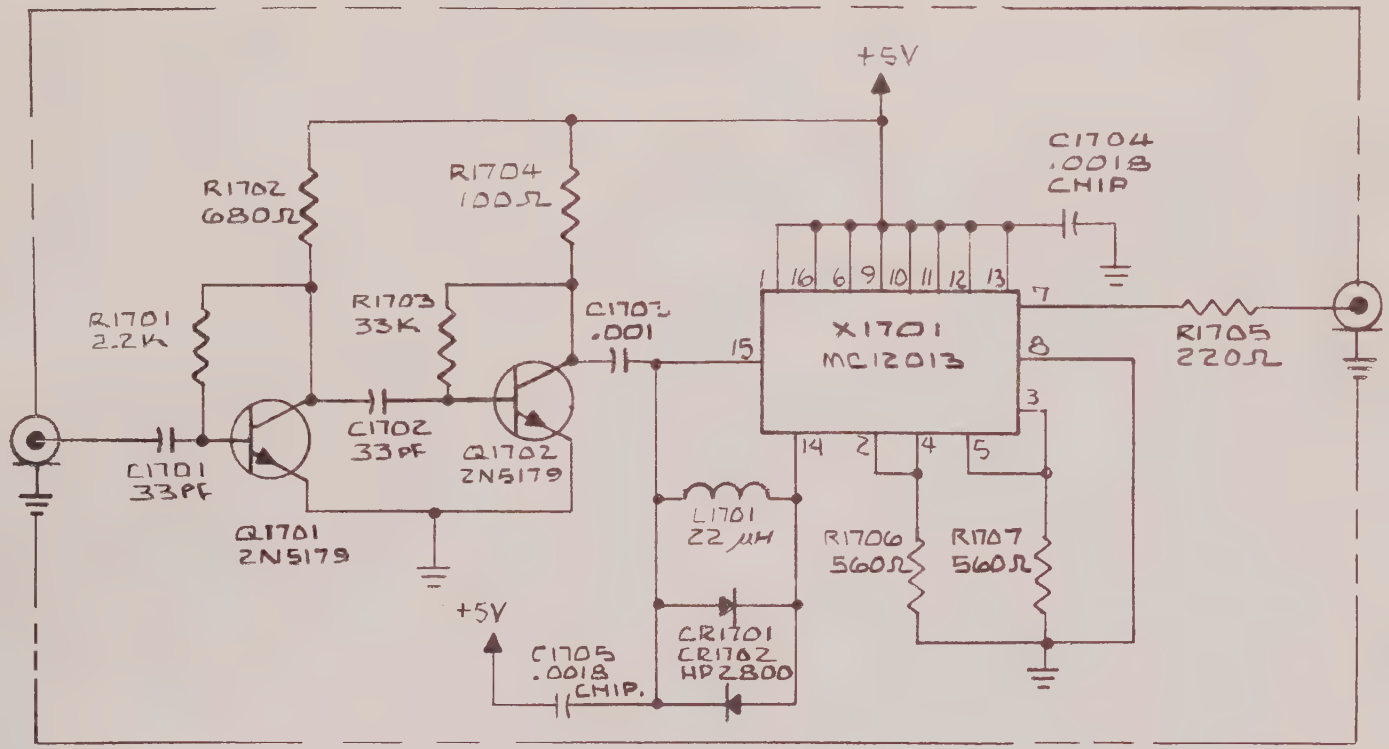
MATERIAL
TREATMENT
FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE
DIGITAL READOUT
BOARD

SIZE
PART NUMBER 3-16-0178
REV
SCALE
WEIGHT
SHEET 4 OF 4

DATE	REV	CHANGE	APP'D



NOTE:
THIS CKT. IS LOCATED ON 12.5KHz BD. (SCHEM. 346-0206) S/N 101-169 & S/N 171-180. ALL OTHER S/N (170 & 181 & UP) WILL HAVE CKT LOCATED ON INSIDE BACK PANEL OF DIGITAL COUNTER ENCLOSURE ASS'Y.

FIG. 9-26

	1	NAV-750	1	1	1-16-0221	COUNTER INPUT DIVIDER
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION

APPLICATION | LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN DATE 1/28/75
CHECKED DATE RR 1/28/75
APPROVED DATE 1-29-75

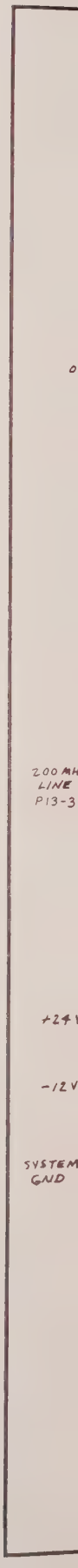
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

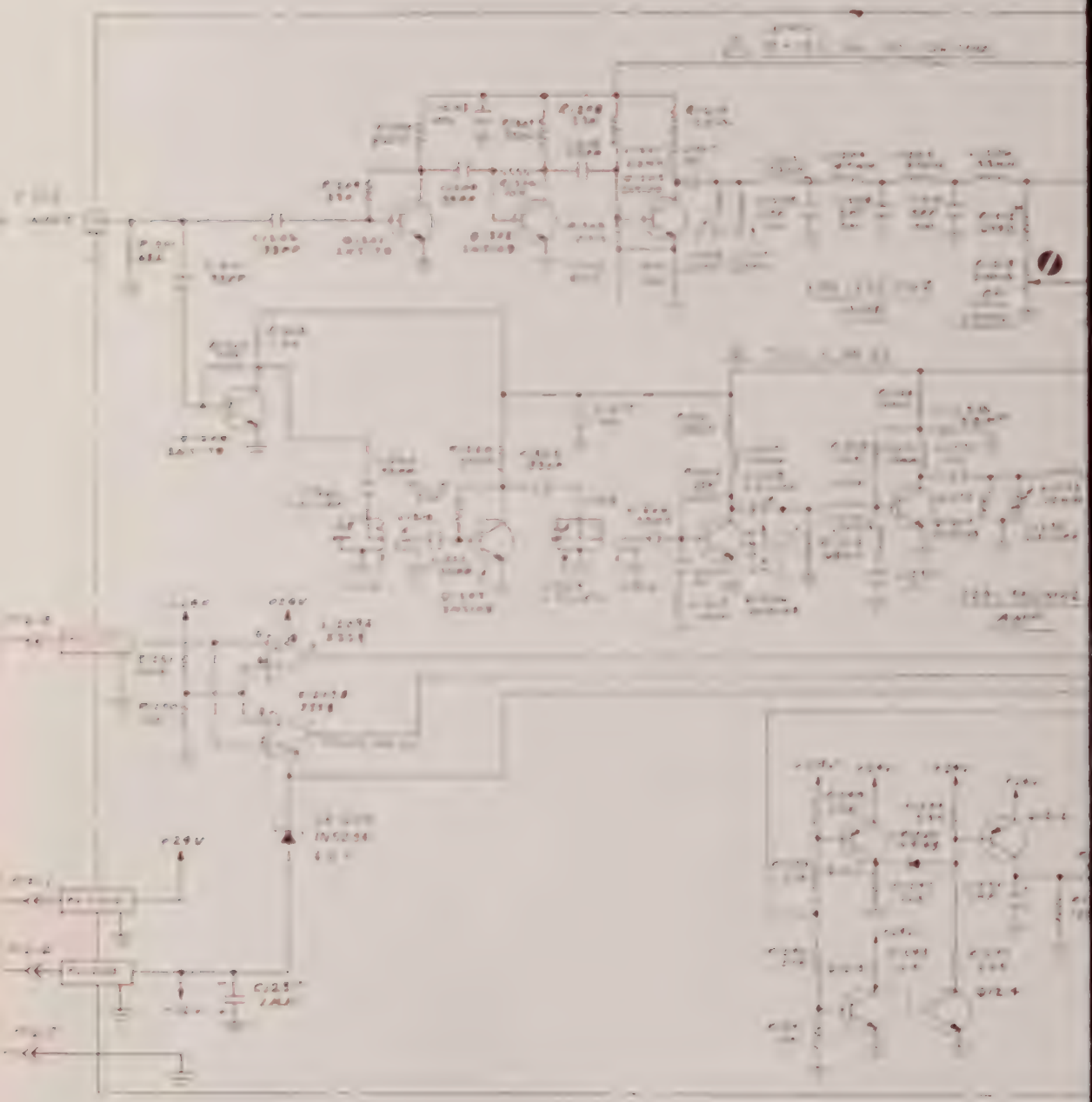
TITLE: COUNTER INPUT DIVIDER

MATERIAL NOTED
TREATMENT —
FINISH —

SIZE | PART NUMBER 1-16-0221 | REV

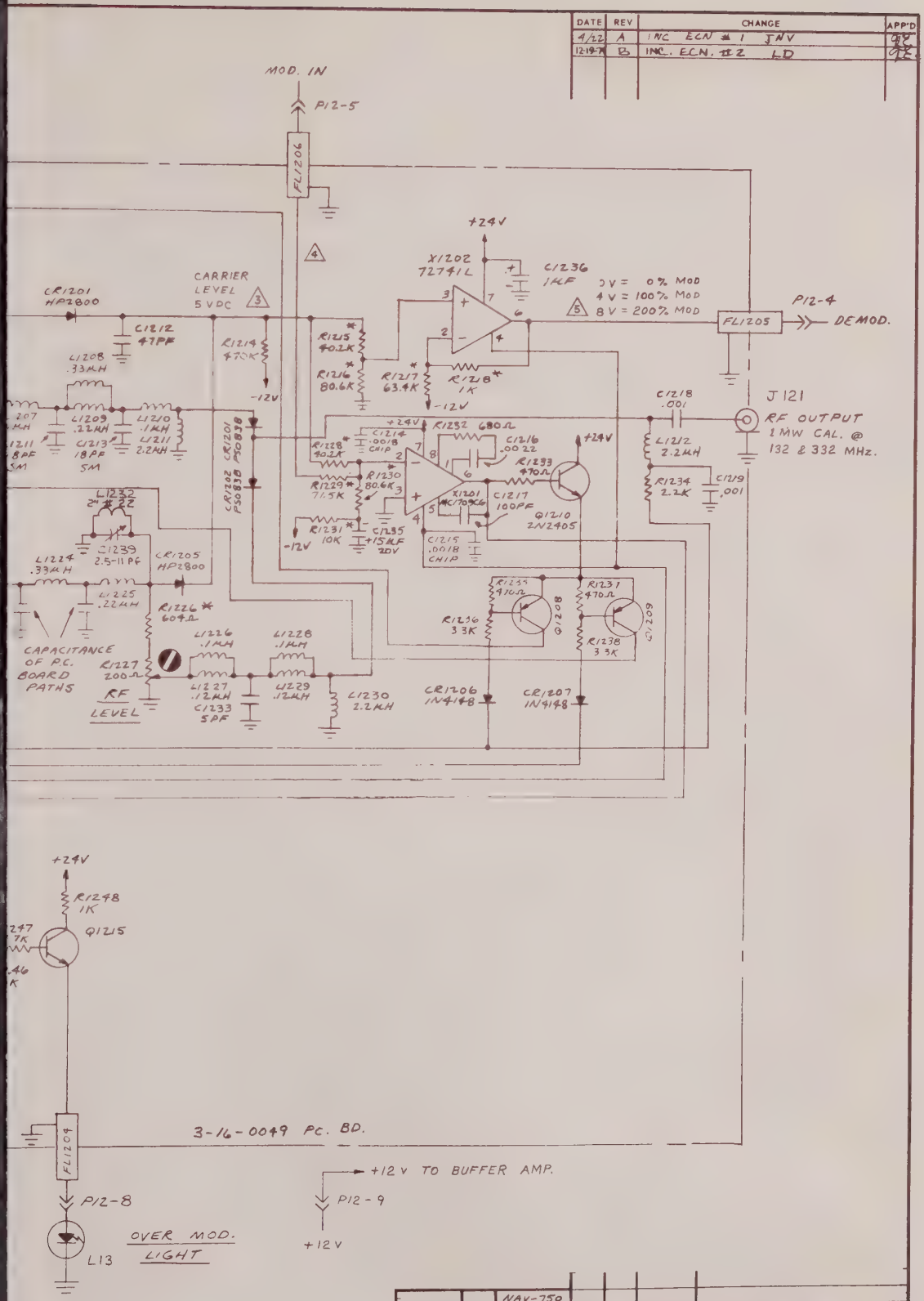
SCALE — | WEIGHT — | SHEET 1 OF 1


200 MH
LINE
P13-3
+24
-12V
SYSTEM
GND



NOTES

1. ALL PNP TRANSISTORS ARE TYPE 2N5966 UNLESS OTHERWISE SPECIFIED
2. ALL NPN TRANSISTORS ARE TYPE 2N3419 UNLESS OTHERWISE SPECIFIED
3. ALL RESISTORS MARKED WITH AN ASTERISK ARE 1% TOL
4. ALL TANT. CAPACITORS TO BE 35V UNLESS OTHERWISE SPECIFIED



NEXT ASS'Y	QT'Y	NAV-750 MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION					LIST OF MATERIALS	

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 REMOVE ALL BURRS
MATERIAL
TREATMENT
FINISH

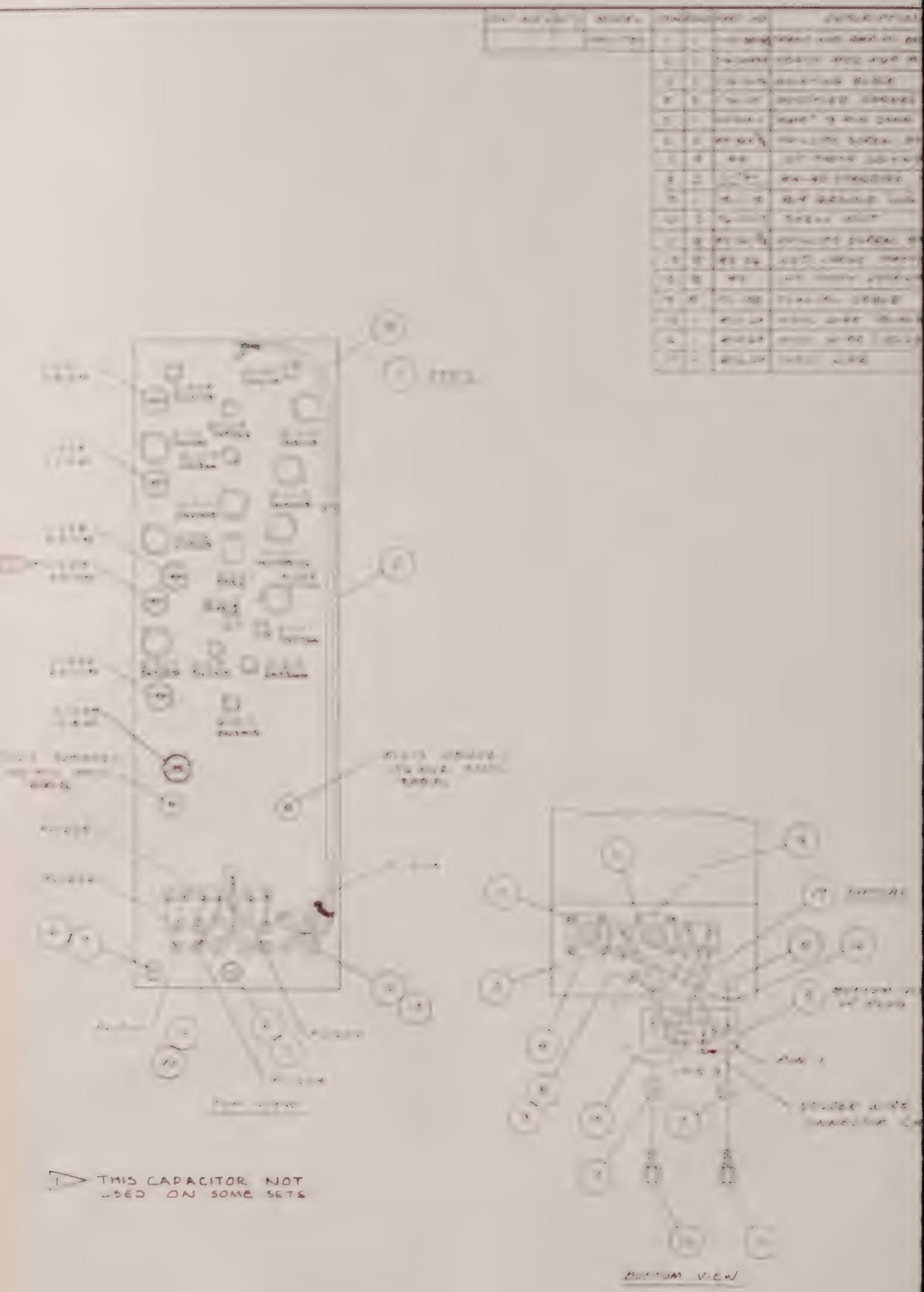
DRAWN JIG 6/11/73
CHECKED RR 11/23/73
APPROVED LL 1-17-74

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: MODULATOR AMPLIFIER SCHEMATIC NAV-750

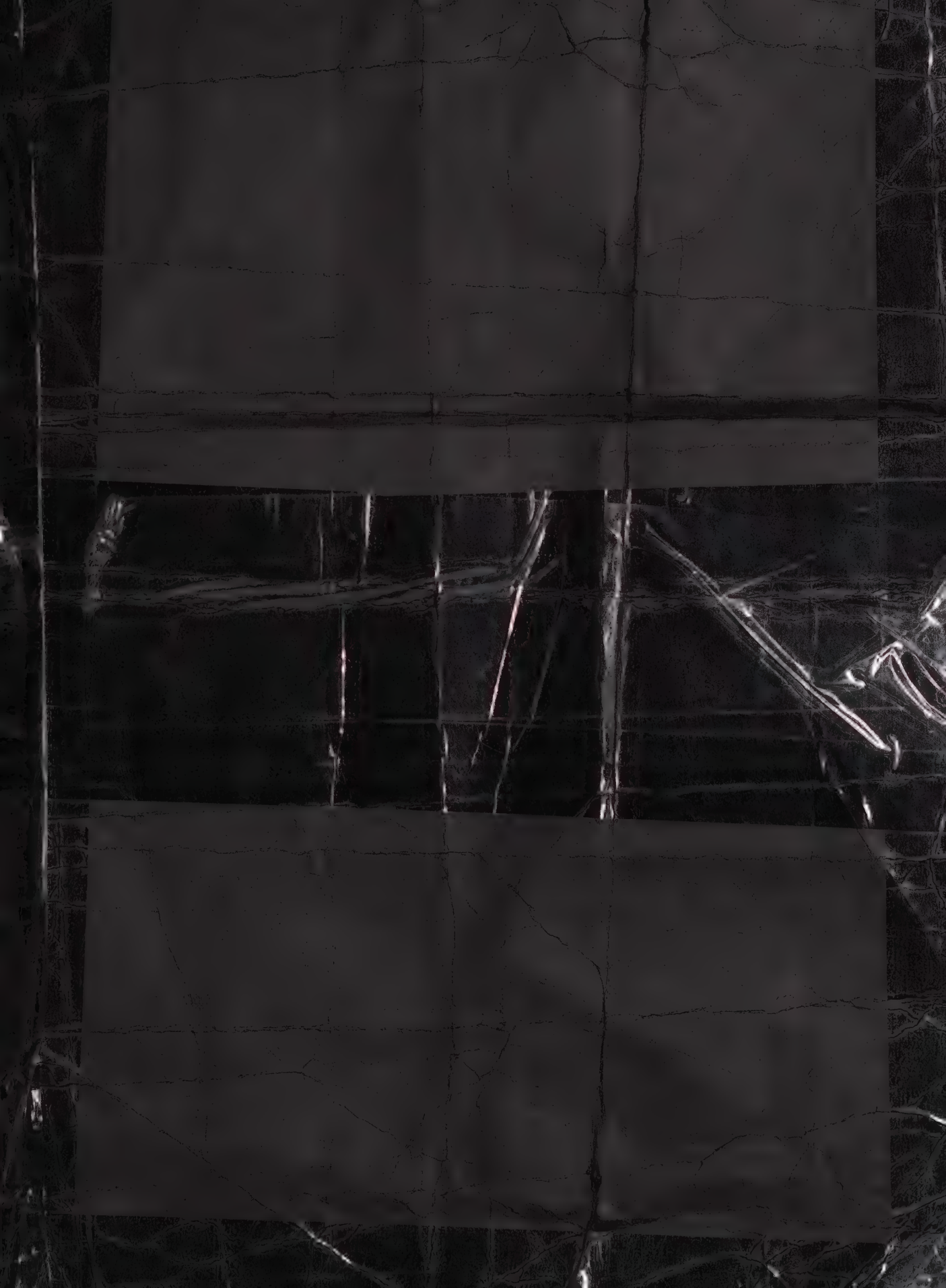
SIZE C | PART NUMBER 3-16-0060 | REV B
SCALE | WEIGHT | SHEET 1 OF 2

FIG. 9-27



1 > THIS CAPACITOR NOT USED ON SOME SETS

BOTTOM VIEW



DATE	REV	CHANGE	APP'D

		NAV-750	1	1	3-16-0060	TRANS MOD. AMP MECH ASS'Y.
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION			LIST OF MATERIALS			

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64 125 ✓
SURFACE ROUGHNESS
REMOVE ALL BURRS

DRAWN JIG 6/13/73
CHECKED MHR 7-3-73
APPROVED WR 2-18-75

MATERIAL SEE MAT'L LIST
TREATMENT
FINISH

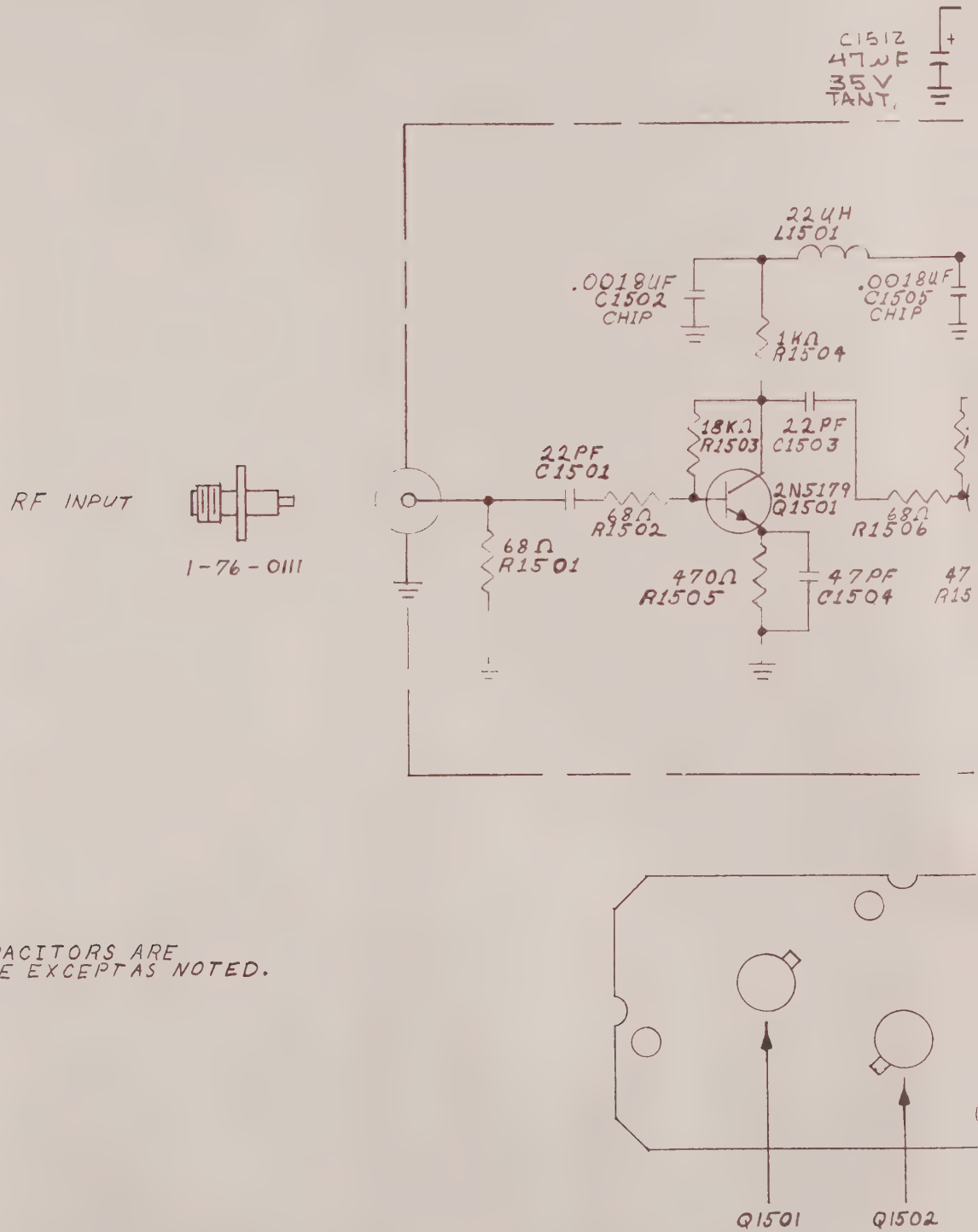
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE TRANS. MOD. AMPLIFIER MECHANICAL ASS'Y. NAV-750

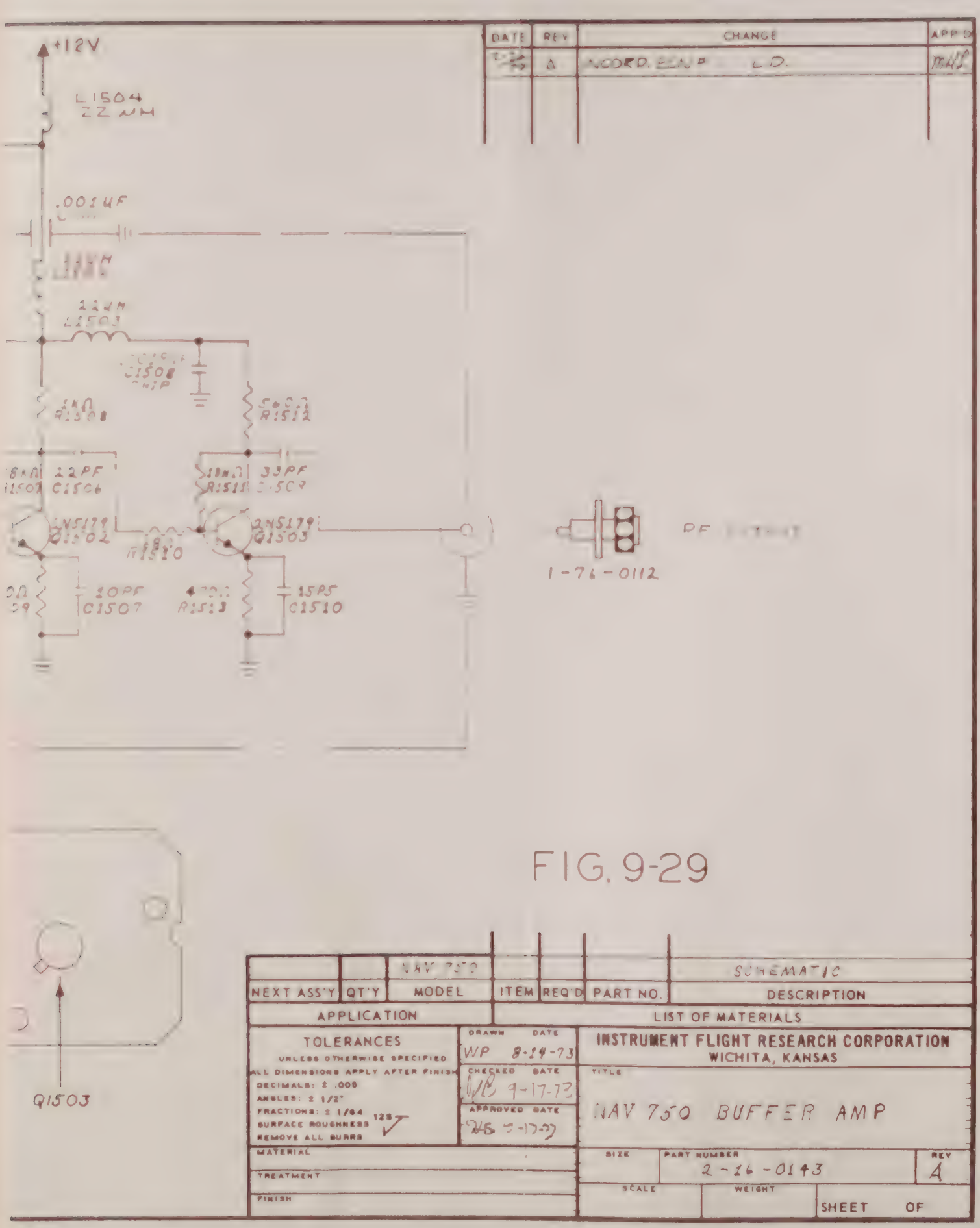
SIZE C | PART NUMBER 3-16-0060 | REV

SCALE 1:1 | WEIGHT | SHEET 2 OF 2

FIG. 9-28

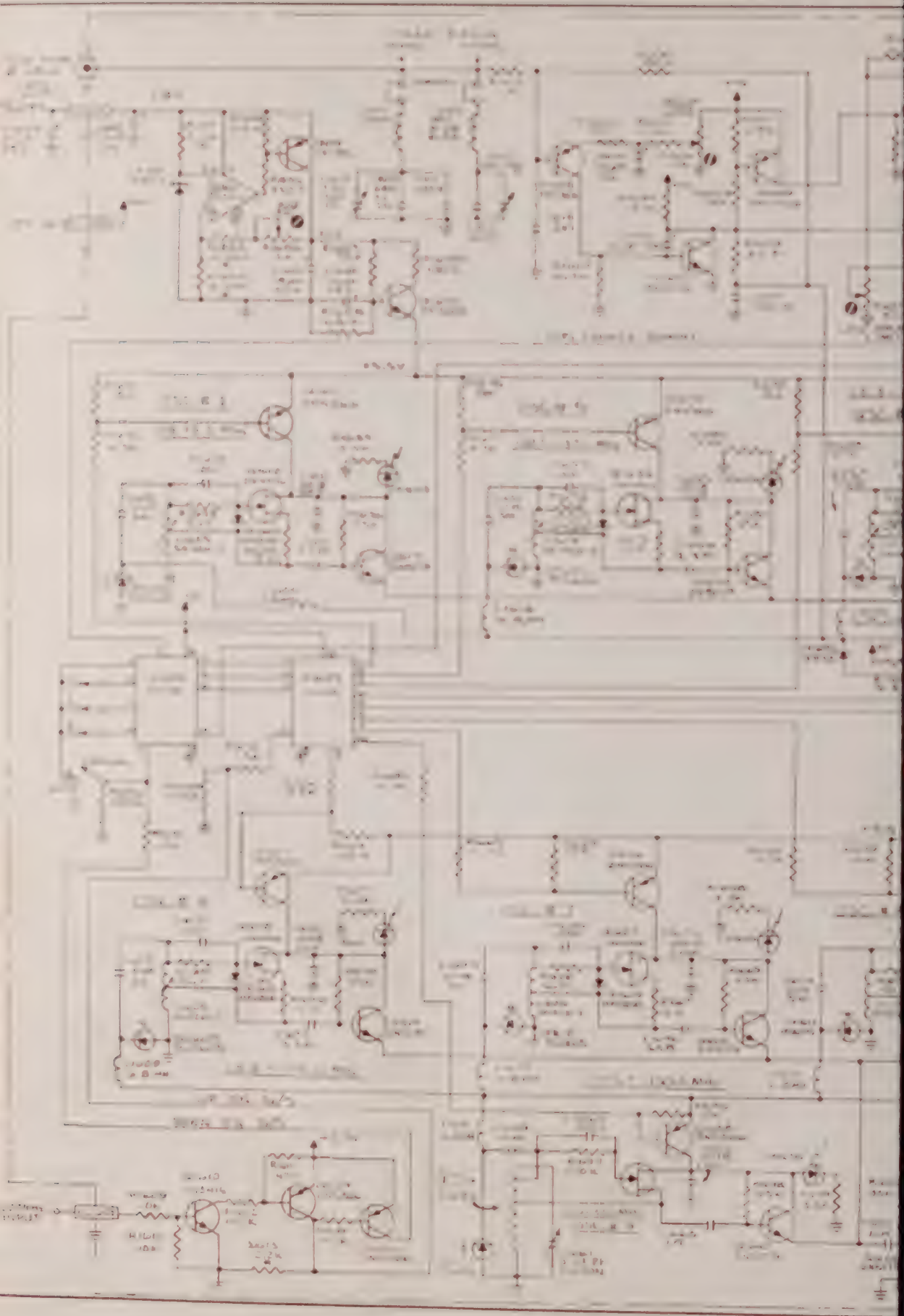


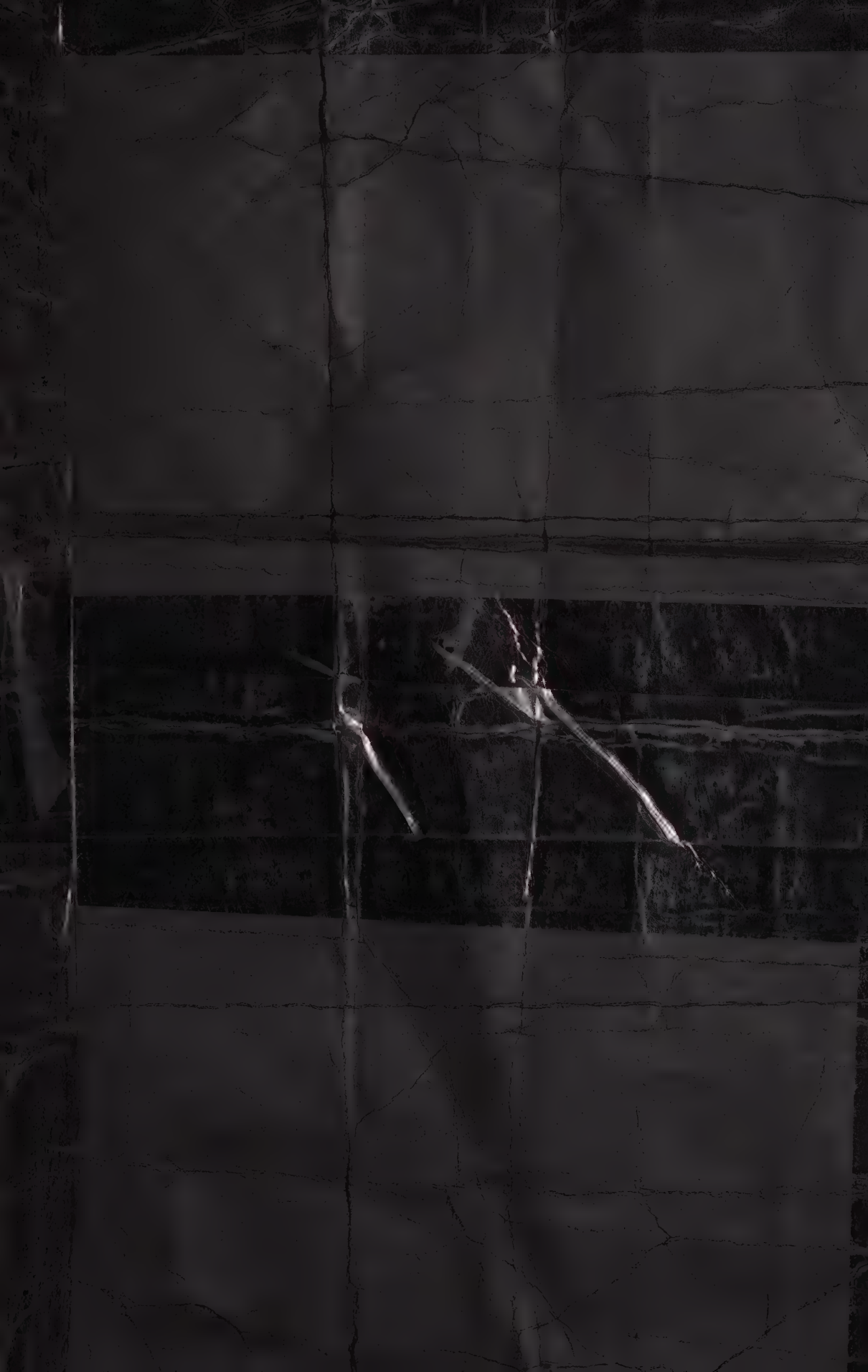
1. ALL CAPACITORS ARE DISC TYPE EXCEPT AS NOTED.



DATE
REV
CHANGE
APP'D
A
NCORD. ECN # L.D.
+12V
L1504
22 μH
.001 UF
22 μH
L1503
C1508
R1508
R1512
22PF
C1506
33PF
2N5179
Q1502
2N5179
Q1503
R1510
10PF
C1507
R1513
15PF
C1510
1-76-0112
Q1503
NAV 750
SCHEMATIC
NEXT ASS'Y
QT'Y
MODEL
ITEM
REQ'D
PART NO.
DESCRIPTION
APPLICATION
LIST OF MATERIALS
TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS
DRAWN DATE
WP 8-24-73
CHECKED DATE
9-17-73
APPROVED DATE
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS
TITLE
NAV 750 BUFFER AMP
MATERIAL
TREATMENT
FINISH
SIZE
PART NUMBER
2-16-0143
REV
A
SCALE
WEIGHT
SHEET OF

FIG. 9-29





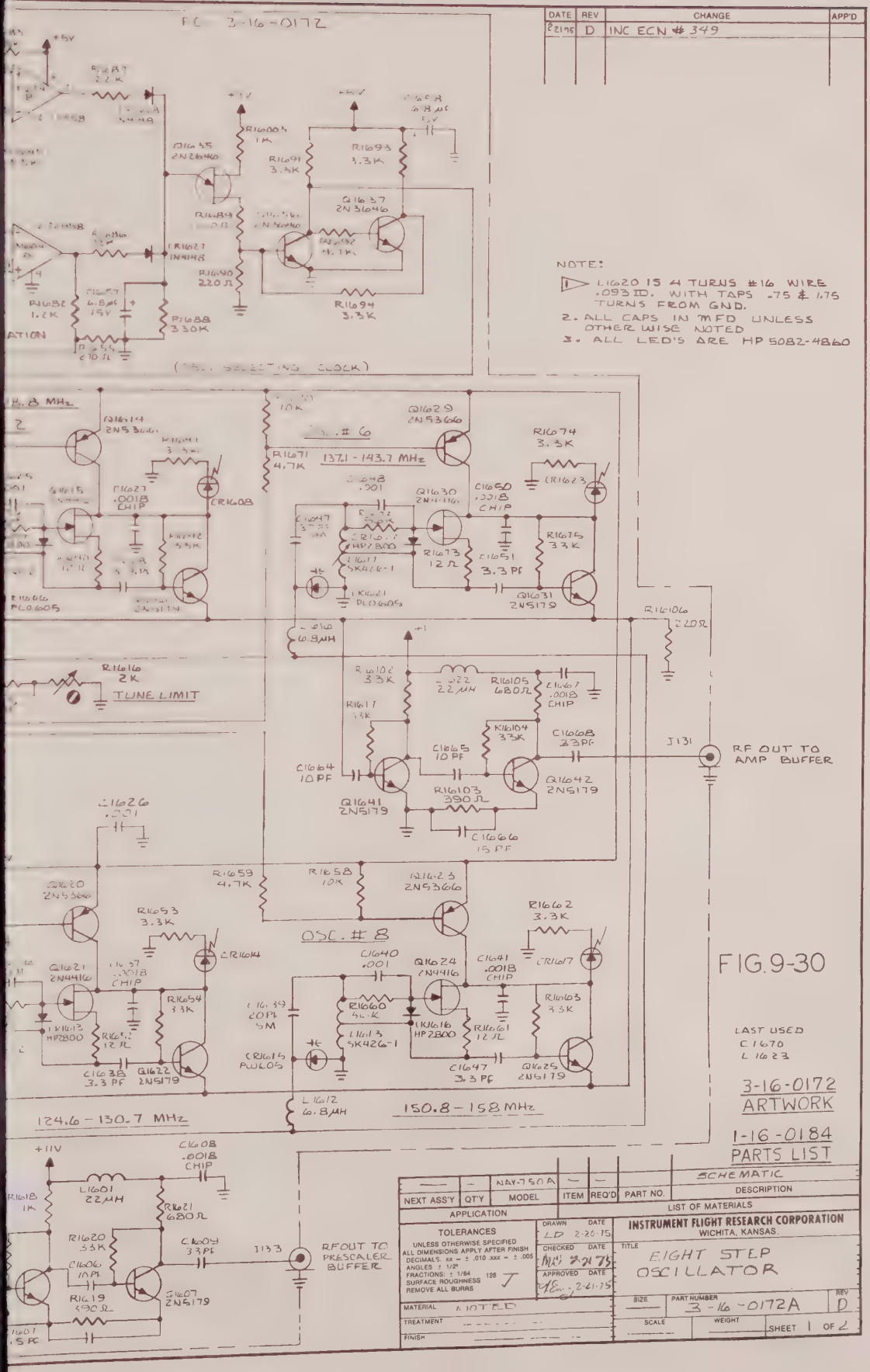
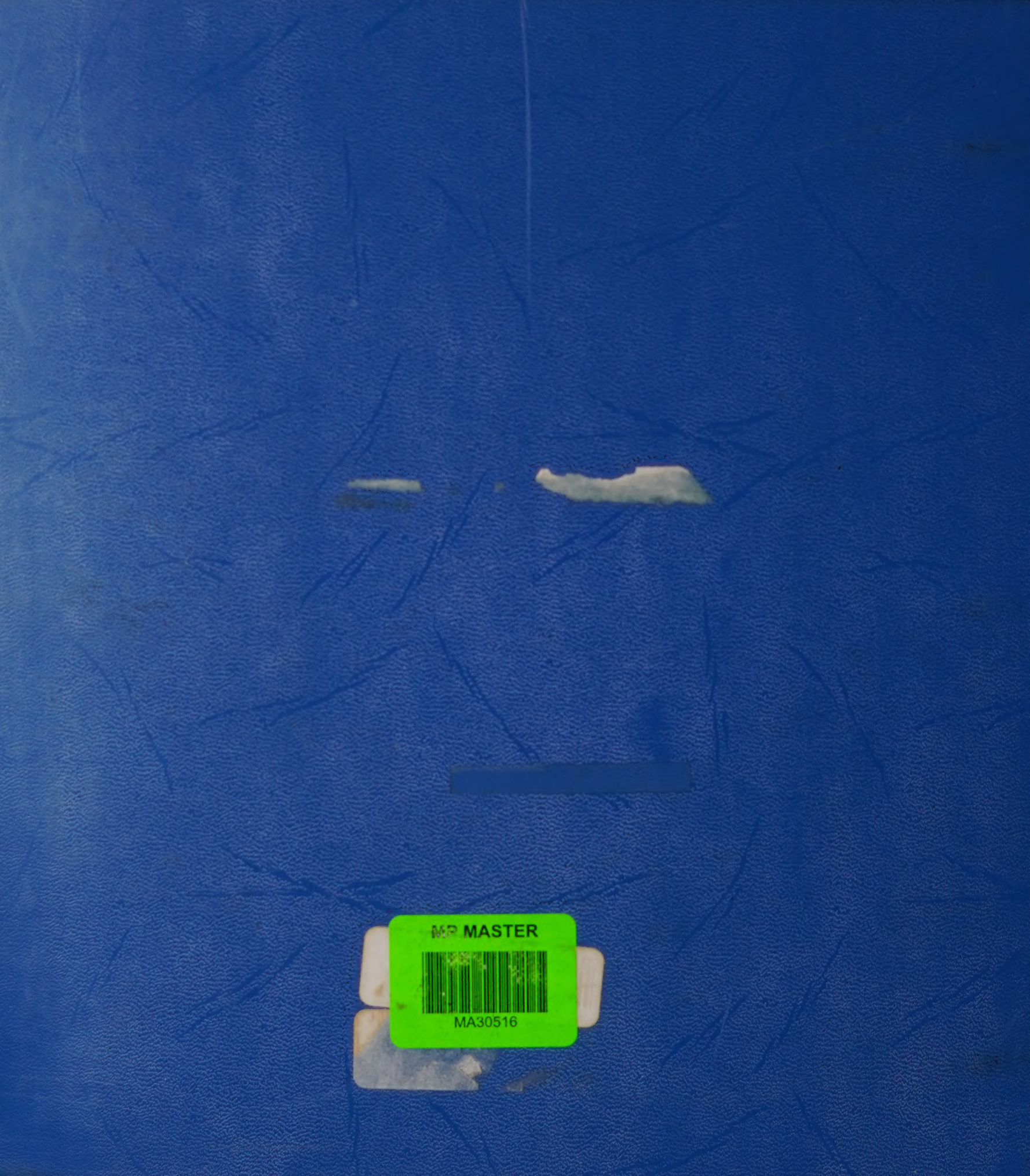

FC 3-16-0172
DATE | REV | CHANGE | APP'D
2215 | D | INC ECN # 349
NOTE:
1. L1620 IS 4 TURNS #16 WIRE .093 ID. WITH TAPS .75 & 1.75 TURNS FROM GND.
2. ALL CAPS IN MFD UNLESS OTHER WISE NOTED
3. ALL LED'S ARE HP 5082-4860
OSC. # 6
137.1 - 143.7 MHz
OSC. # 8
124.6 - 130.7 MHz
150.8 - 158 MHz
TUNE LIMIT
RF OUT TO AMP BUFFER
RF OUT TO PRESCALER BUFFER
FIG. 9-30
LAST USED
C 1670
L 1623
3-16-0172 ARTWORK
1-16-0184 PARTS LIST
SCHEMATIC
LIST OF MATERIALS
NAV-750A
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.
EIGHT STEP OSCILLATOR
3-16-0172A
D
SHEET 1 OF 2

FIG 6-25 6-27 FIG 6-26 FIG 6-28


MP MASTER
MA30516